FEBRUARY
1920
25 cts.

ELECTRICAL EXPERIMENTER

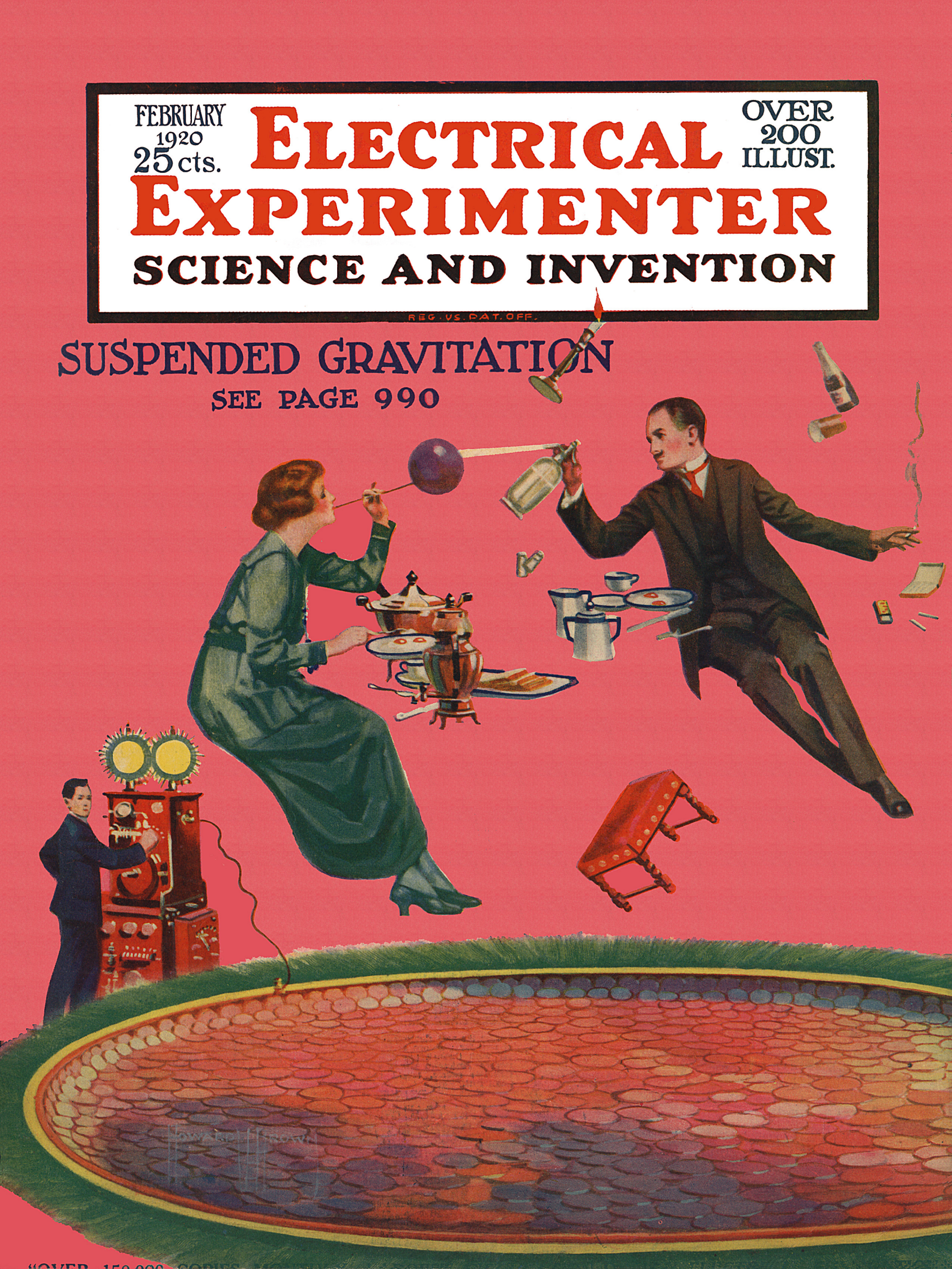
SCIENCE AND INVENTION

OVER
200
ILLUST.

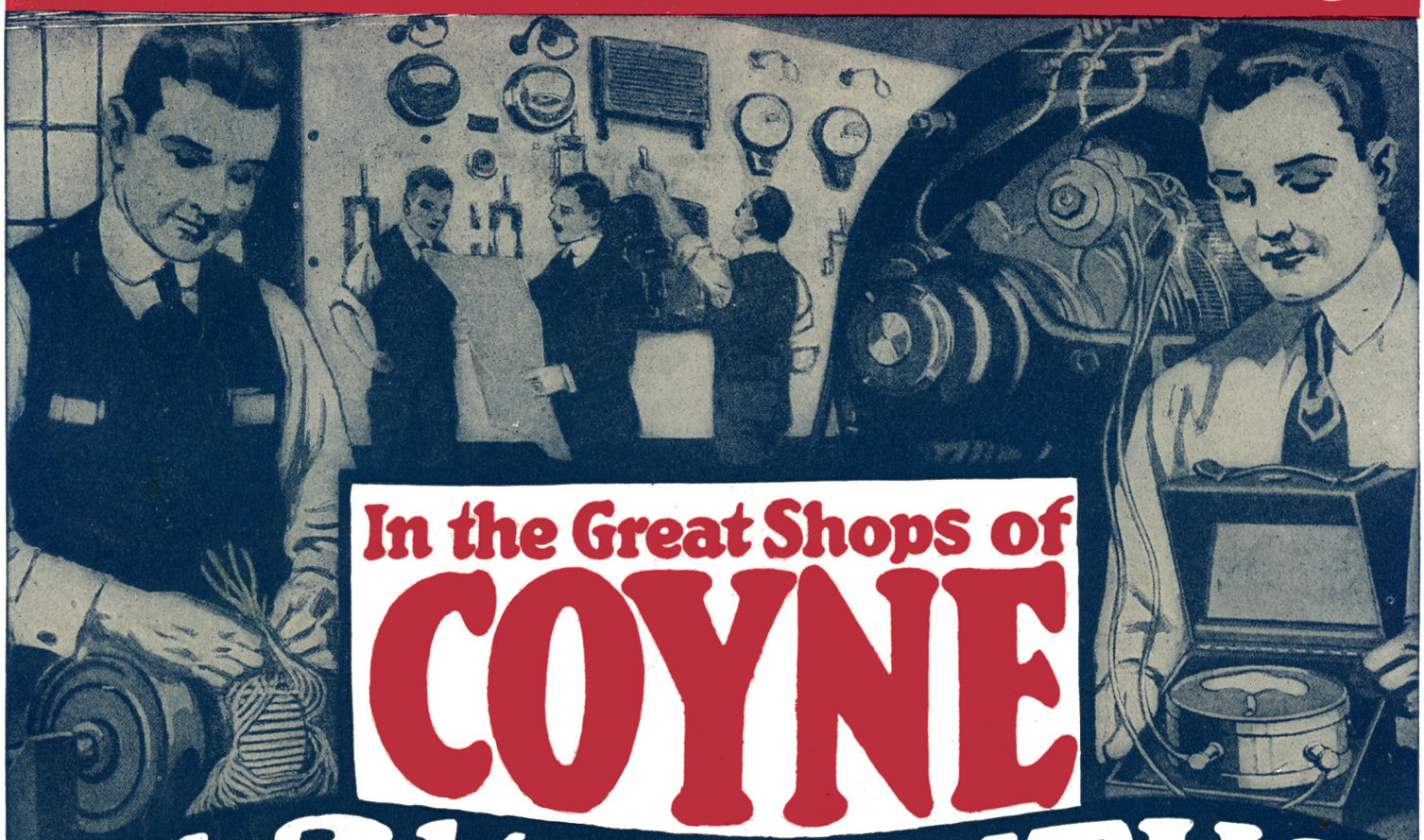
REG. U.S. PAT. OFF.

SUSPENDED GRAVITATION

SEE PAGE 990



Learn Electricity



In the Great Shops of COYNE IN 3½ MONTHS

Thousands of Electrical experts are needed to help rebuild the world. Come to Chicago to the great shops of Coyne and let us train you quickly by our sure, practical way, backed by twenty years of success. Hundreds of our graduates have become experts in less than four months. *You* can do the same. *Now* is your big opportunity. Come—no previous education necessary.

Earn $125 to $300 a Month

In the Electrical business. Come here where you will be trained in these great $100,000 shops. Experts show you everything and you learn right on the actual apparatus. You work on everything from the simple bell to the mighty motors, generators, electric locomotives, dynamos, switchboards, power plants, everything to make you a master electrician. We have thousands of successful graduates. Just as soon as you have finished we assist you to a good position.

Become An Expert in 3½ Months

No need of taking from 1 to 4 years to become an expert, we have proved this in thousands of cases. The Coyne method of practical training eliminates all books, useless theory and other non-essentials and trains you in just what you need to know to become an expert.

Earn Your Way

Dozens of our students every year work in their spare time and earn their living expenses. Dozens of others work in the day time, earn all their expense and attend our evening school. Our employment department will help you without charge.

Send Today for Big Free Book

Write today, *now*, for the book. It tells what Coyne graduates have done. What you can do. Fill in the coupon, check the trade you are most interested in or send a postal card, do it *now*.

Simplest Instruction Known

You need have no previous experience before coming here, for we start you on the simplest things. Experts stand beside you to guide and instruct you while you do the actual work with your own hands just exactly as you will later do it with your diploma as Master Electrician. You learn everything so you can handle the big jobs that are offered to Coyne graduates.

LEARN DRAFTING

Practical instruction in large drafting rooms in big shops with experts standing beside you. Learn Mechanical Drafting and Machine Design, including Automobile Design, with actual machinery around you. Take Builders' Course or Architectural Drafting with Bricklaying students actually carrying out your plans. Coyne graduates in demand. We place graduates in good positions.

Motion Picture Operating

During the past eleven years we have trained hundreds of men for positions as Chief Operators at $25 to $50 per week through practical instruction by experts in modern Projection Rooms with all types of machines. Complete course, taught thoroughly yet quickly, at small cost.

DAY OR EVENING COURSES

Don't worry about the money. Anyone with ambition can learn here. Our tuition is low with small easy payments if desired. All tools and equipment is furnished free. Our students live in comfortable homes in the best section in Chicago—on the lake—just a few minutes' walk from our school.

COYNE TRADE AND ENGINEERING SCHOOLS
Bennett W. Cooke, President
Dept. 22, 39-51 E. Illinois St., Chicago, Ill.

Please send at once your big Free Book—I am interested in

[ ] Electricity [ ] Drafting
[ ] Motion Picture Operating
(Check trade interested in)

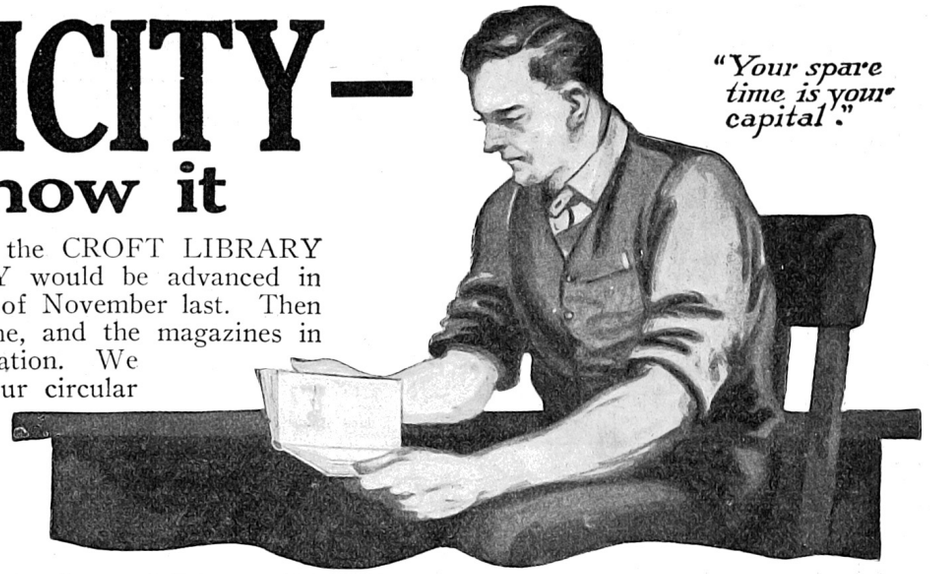
Name.....

Address.....

BENNETT W. COOKE, *President*
COYNE TRADE AND ENGINEERING SCHOOLS
Dept 22 39-51 E. Illinois Street, Chicago, Ill.

MAIL COUPON FOR FREE BOOK NOW

ELECTRICITY—
as experts know it



"Your spare time is your capital."

FEBRUARY 28 IS THE LAST DAY

Sometime ago we announced that the CROFT LIBRARY OF PRACTICAL ELECTRICITY would be advanced in price from $16 to $20 on the 29th of November last. Then the New York printers' strike came, and the magazines in which we advertise stopped publication. We were likewise unable to get out our circular matter.

$16 now— $20 later

In justice to all, the old price will remain in effect until February 28th, 1920. After that date the price of the Croft Library will never again be sold for less than $20.

Positively the last chance

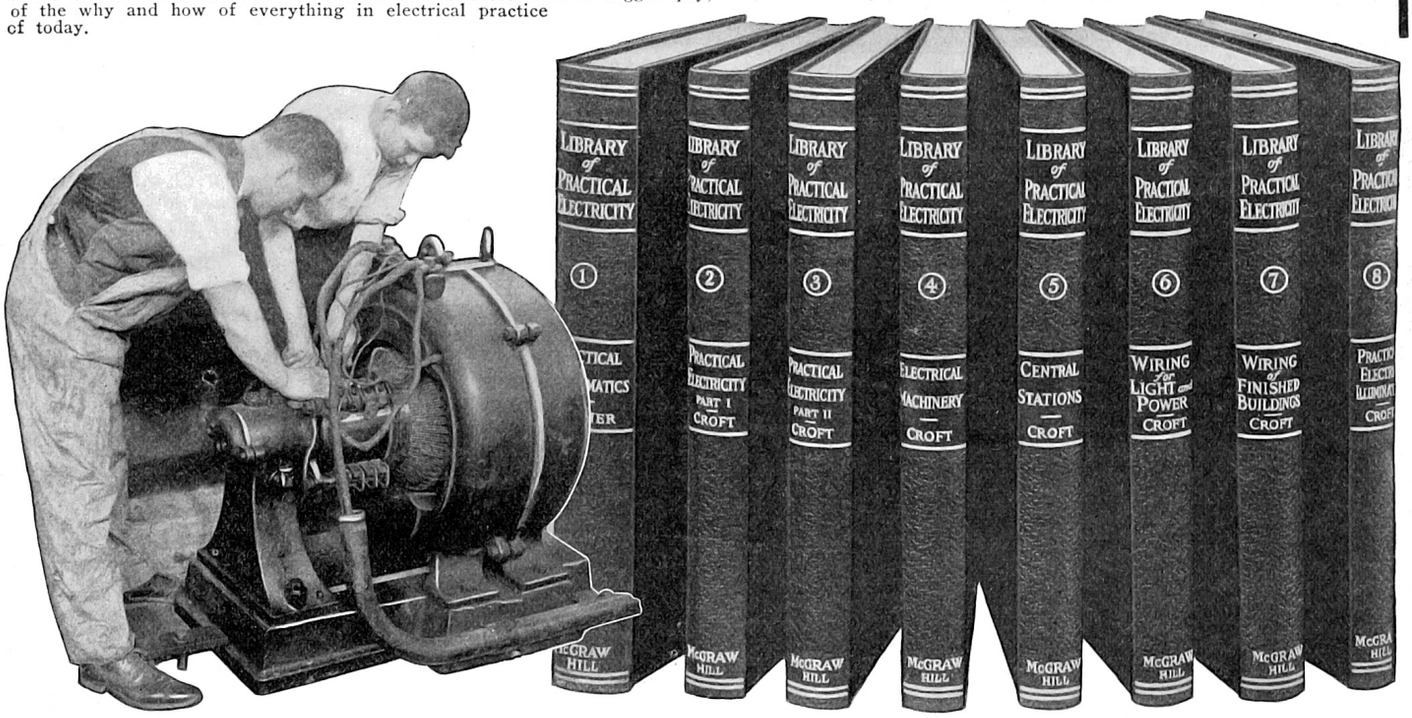
This is your opportunity to procure a complete electrical education at the low price of $16, payable $2 per month. This is your chance to know electricity as experts know it.

The only library of its kind--

There never has been a set of books or a course on electricity that adhered so closely to actual electrical practice. The author, Terrell Croft, procured his knowledge with his sleeves rolled up. He was trouble shooter, draftsman, wireman, central station operator—then electrical engineer for the Westinghouse Company. He is a practical man and knows the exact wants of his fellow workers. He tells of the short cuts to bigger pay, of the why and how of everything in electrical practice of today.

Learn while you earn

NOT ONE CENT DOWN payable $2 per month MERELY RETURN THE COUPON BELOW



8 Volumes Flexibly bound Pocket Size 3000 pages 2100 illustrations Everything you must know about electricity at the finger's end

A letter that means something to YOU—

McGRAW-HILL BOOK COMPANY, Inc., 239 W. 39th St., New York, N.Y.

Gentlemen:—In an attempt to express myself about CROFT'S NEW LIBRARY OF PRACTICAL ELECTRICITY, I have never seen, and do not believe there was ever printed in the English language, a more comprehensive set of books. It is a library that is just as valuable to the novice as to the expert, because it is all practice.

Respectfully,
GUY H. PEIFER,
Chief, Doplan Silk Corporation,
Hazelton, Pa.

McGraw-Hill Book Co., Inc.
239 West 39th Street New York

FREE EXAMINATION COUPON

After February 28, 1920, price of the set $20

McGraw-Hill Book Co., Inc.
239 W. 39th St., New York.

Gentlemen:—Please send me the Library of Practical Electricity (shipping charges prepaid), for 10 days' free examination. If satisfactory I will send $2 in ten days and $2 per month until $16 has been paid. If not wanted, I will write you for return shipping instructions.

Name .....
Home Address .....
City and State .....
Where Employed .....
Occupation ..... (Ex. 2-20)

Electrical Experimenter

233 FULTON STREET, NEW YORK

Publisht by Experimenter Publishing Company, Inc. (H. Gernsback, President; S. Gernsback, Treasurer; R. W. DeMott, Sec'y), 233 Fulton Street, New York.

The Unknown Senses

THE normal human being has five senses: Sight, touch, hearing, scent, taste. With these five senses we perceive what is going on about us, in a very incomplete manner. Altho we pride ourselves as the most accomplisht animal in all respects, this is far from the truth. The fact is that the only thing we can pride ourselves with is our reasoning power—and even here the ants and bees outdistance us considerably.

As to our five senses they are neither well developed nor remarkable. A good dog sees better, hears better and smells infinitely better. His taste, too, is better or rather sharper. Only his touch is not as perfect as the human's. But he makes up for this by a sense, not at all possest by man. We refer to the sense of "location". Take a dog—the experiment has been made innumerable times—and put him in a trunk; then ship him by auto or by train a dozen miles or more. Release him and the dog will find his way home, nine times out of ten. He could not scent his way home, but a mysterious sense, the sense of location will bring him back. Cats are notorious for the same sense, hence the saying "and the cat came back."

In ants too, this sense is highly developed. So is the wasp's. The famous French entomologist Fabre painted the abdomen of a dozen wasps with white paint. Each insect was then thrust into a small paper tube. All the cylinders were then placed into a tightly closed box which was transported two miles from the wasps' nest.

After liberating the insects they made off in various directions, but five hours afterwards ALL of them had returned to the nest. This experiment proves conclusively that the wasps could not have returned either by a sense of smell or sight. Hence they must have another sense: the sense of "location", or the sense of "orientation" as it is sometimes called.

We can only speculate upon the physics of this mysterious sense, nothing positive is known about it so far.

The wasp, or for that matter the dog may either be influenced by the slightest barometric difference of pressure, or by the condition of the air, such as humidity, etc. If they are hyper-sensitive to such changes, they would naturally try to regain the spot where the conditions are such as those to which they have been accustomed all their lives.

And while Einstein ignores the existence of the ether—and many modern physicists do, because of no experimental proof of the hypothetical fluid, the biologist seems to think that this sense of location can only be due to some—to us unknown— mysterious wave motion in the ether. Indeed this theory gains much plausibility when we see continuously reports of homer pigeons, who so it is maintained, are influenced by radio waves. A recent press report from England stated that homer pigeons never find their way back to a ship or land station that continuously sends out radio messages. But if no messages are sent, the pigeon will return in due time. We may add that this report needs verification.

Space does not permit a lengthy list of other strange senses of the lower animals, but many do exist. We desire to mention, however, a mysterious sense of the bat. A Frenchman totally blinded a bat. He then let it fly about in a room criss-crost with fine wires and strings. But the bat never once touched one of them, altho flying rapidly all the while. No satisfactory explanation has ever been given for this phenomenon.

It would be a wonderful help to humanity if some rich man would endow a laboratory for the investigation of the lower animals' extra senses.

H. GERNSBACK.

Vol. VII. Whole No. 82 **Contents for February, 1920** **No. 10**

SUSPENDED GRAVITATION.....Front Cover
From a painting by Harold Brown
ELECTRIFYING THE HOLY LAND..... 983
SUB-SEA EXPLORATION..... 984
By Joseph H. Kraus
THE GODDARD MOON ROCKET..... 986
THE VERSATILE AUDION.....1000
By H. Winfield Secor
SUSPENDED GRAVITATION..... 990
By H. Gernsback
HOW BECQUEREL DISCOVERED RADIOACTIVITY..... 994
By Jean Becquerel
THE GOLDEN VAPOR—A REAL SCIENTIFIC STORY..... 997
By E. H. Johnson
HITTING INVISIBLE TARGETS.....1003
KING OF SIAM ELECTRIFIES HIS PALACE.....1004
POPULAR ASTRONOMY 1008
By Isabel M. Lewis, M. A., "Meteorites"
THE GIANT CANADIAN REFLECTOR.....1010
By Prof. Floyd L. Darrow
PERPETUAL MOTION CONTEST AWARDS.....1013
THE NEW THEORY OF ELECTRICAL MASS.....1014
By Rogers D. Rusk, M.A.
EXPERIMENTS IN PHYSICS-RESONANCE AND TUNING.....1015
By John J. Furia, A.M.
PRACTICAL CHEMICAL EXPERIMENTS—ALCOHOL—START OF A NEW SERIES IN EXPERIMENTAL CHEMISTRY.....1016
By Prof. Floyd L. Darrow
A COMPREST AIR MODEL AIRPLANE MOTOR.....1018
By W. J. Beach, M.E.
EXPERIMENTS IN THERMOGRAPHY.....1021
By Thomas W. Benson
THE HORN TYPE OF SOUND LOCATOR.....1022
By Charles K. Fankhauser, Jr.
THE ELECTRICAL MACHINIST NO. 4, MACHINING FIELD CASTINGS 1023
By H. Winfield Secor
WRINKLES, RECIPES, AND FORMULAS.....1026
Edited by S. Gernsback
AUDIONS STRONGER THAN THE SUN.....1027
VACUUM TUBE CIRCUITS.....1028
By Ensign Pierre H. Boucheron, U. S. N. R. F.
RADIO TELEPHONY AND THE AIRPLANE.....1030
By William C. Mundt
PATENT SUGGESTIONS—WHAT TO INVENT.....1034
By Jay G. Hobson

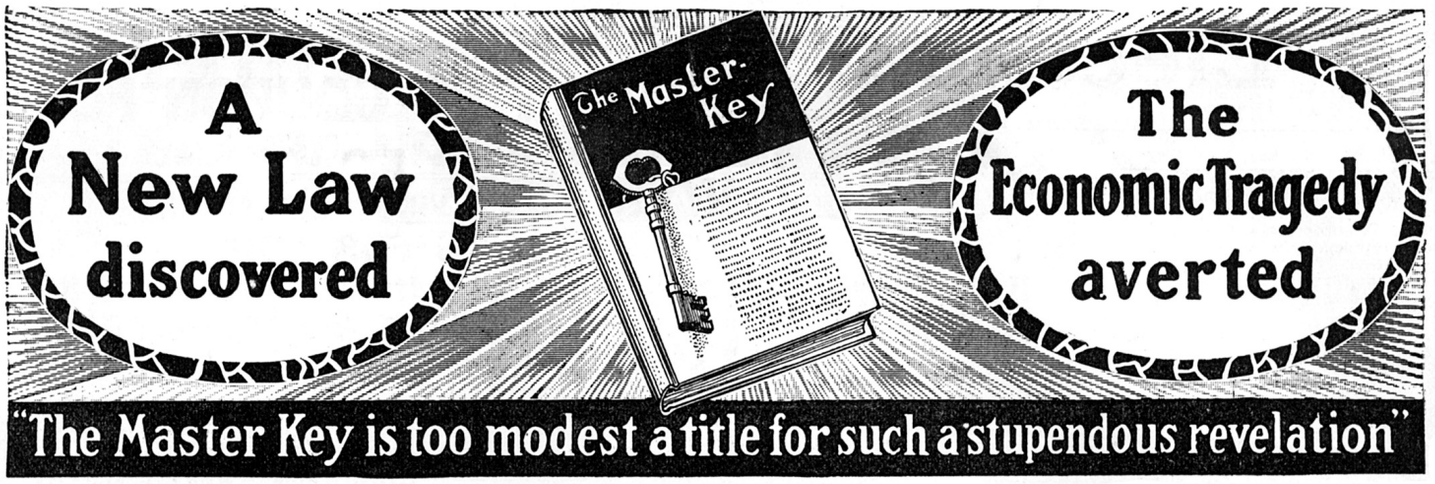
The **ELECTRICAL EXPERIMENTER** is publisht on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. Subscription price is $2.50 a year in U. S. and possessions. Canada and foreign countries, $3.00 a year. U. S. coin as well as U. S. stamps accepted (no foreign coin or stamps). Single copies, 25 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of EXPERIMENTER PUBLISHING CO., Inc. If you change your address notify us promptly, in order that copies are not miscarried or lost.

All communications and contributions to this journal should be addrest to : Editor, ELECTRICAL EXPERIMENTER, 233 Fulton Street, New York. Unaccepted contributions cannot be returned unless full postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

ELECTRICAL EXPERIMENTER. Monthly. Entered as second-class matter at the New York Post Office under Act of Congress of March 3, 1879. Title registered at the Patent Office. Copyright, 1920 by E. P. Co., Inc., New York. **The Contents of this magazine are copyrighted and must not be reproduced without giving full credit to the publication.**

The ELECTRICAL EXPERIMENTER is for sale at all newsstands in the United States and Canada; also at Brentano's, 37 Avenue de l'Opera, Paris. Sole British Agents—Geoffrey Parker & Gregg, 62 and 8A The Mall, Ealing, London.

Member of the Audit Bureau of Circulation.



"The Master Key is too modest a title for such a stupendous revelation"

One reader says, "The Master Key is too modest a title for such a stupendous revelation." Another says, "It is the most wonderful teaching ever conceived." Another says—

"I am able to extract from this system all that can be made known by the finite mind relative to origin, revolution, destiny and the much-mooted riddle of the Universe."

"You have led a hungry world to the threshold and placed in their hands a key with which the understanding ones may unlock the door and enter the secret place of the most high and enjoy the abundance of all good to be found therein."

"The Master Key is the answer to the demand, 'Knock and it shall be opened.' All the world seeks this wonderful key."

"I have found the Master Key and with it I am each day unlocking the storehouses of wealth and wisdom concerning which I was heretofore in utter ignorance."

The lash of circumstances and the logic of events, are more than ever, impelling men to think. A philosophy of life having as its basis blind optimism, a religion that won't work seven days in a week or a proposition that is not practical, appeals to the intelligent, not at all. It is results that we want, and the acid test is—will it work? The Master Key qualifies! Intelligence rules. Thought, intelligently directed, automatically causes its object to manifest on a material plane. CHARLES A. HEARD.

The apparent impossibilities are the very things that help us to realize the possible. We must go over the unbeaten "trail of thought across the mountain of ignorance," wade through the "swamp of superstition" and cross the canyons of "rites and ceremonies" if we ever expect to come into the "promised land of revelation."
JOHN A. BOSTIC.

You have synthesized the wisdom of the East and the West and given it in a manner so logical and penetrating, that by its aid one is able to distinguish wisdom from sophistry, truth from delusion, spiritual expression from psychic vagaries, and the sublime operations of spiritual insight and intuition from deceptive visions and false revelations. You have successfully taken the mystery out of mysticism and placed all propositions in the clear light, so that "He who runs may read." I consider you a true benefactor to the world.
G. H. GIBBONS.

Mr. Edgar Lucian Larkin, the world-renowned scientist and director of the Mount Lowe Observatory at Pasadena, California, says, "Its teaching is precisely in line with the wonders of the most recent psychology. All persons having desks should have this book thereon, and it would be a fitting pocket companion."

The Rev. Charles H. B. Powell says, "Our Fathers did eat manna in the wilderness, but they are dead. The Master Key gives us the Living Bread of Wisdom and Knowledge."

The Master Key is free.

It will be sent without cost or obligation.

CHARLES F. HAANEL

203 Howard Building, St. Louis, Mo

The Master Key is for you.
You will enjoy it.
You will welcome it
You will profit by it.

It will bring you all that is best and most beautiful in life, because it is attuned to higher things.

The Master-Key System is the solvent for the world's social, economic, industrial, and political ills. In order to stabilize civilization it becomes necessary to establish a system of education that will constructively and systematically develop the mental faculties and moral forces of man. It is a pressing need in order to save humanity from utter destruction.

The Master-Key System is taught in no school, in no college, in no university, or in no text-book. There is one way only to get it—just one—an easy and simple way—yet many neglect it. They would not be so careless if they realized the joy, the inspiration, the courage, the independence which is coming into the lives of those who are more thoughtful.

Creative power is the ability to bring into manifestation things which did not heretofore exist in the objective world. It is therefore the greatest power there is, because it means an actual contribution to the wealth of the world. If you develop this kind of power, you can hold a certified check on the bank of civilization for a fortune.

In contradistinction to this system of constructive thinking, note what a director of one of our largest universities says: "My students can neither think nor speak. They have in general a low degree of power to seize the organizing thought of chapter or book—reckless thought—aviation without steering apparatus and little experience in starting a train of thought and conducting it on a straight track to some terminus; paralyzing embarrassment on being left alone with a problem; lack of resourcefulness for new uses of old knowledge; no resourceful command of mental business method."

(A simple knowledge of the ability of the individual to create conditions for himself will unerringly and inevitably change this negative thought to a positive, dominant, creative thought, which will open up a wonderful vista of possibilities, broaden the outlook on life, and show how effort to accomplish may be rewarded with certainty. A wonderful promise, is it not?)

But do not be deceived. Reading books, magazines, attending lectures, taking home study courses will never put you in possession of the "Master-Key." It is only by a conscious co-operation with natural laws that we are enabled to "enter and partake." The Master-Key System teaches the method whereby this may be accomplished. In this it is DISTINCTIVE, ORIGINAL, UNUSUAL and AUTHORITATIVE.

The Master-Key System is easy to understand, the results are certain, definite, positive and permanent. There is accordingly, no reason in the world why YOU should not have it. NOT ONE!

A Master Key will be sent to any address without cost or obligation of any kind.

CHARLES F. HAANEL

HOWARD BUILDING ST. LOUIS, MISSOURI

This Advertisement ***contains a message of such transcendental importance that no reader of Electrical Experimenter, whether man, woman, or child, should fail to answer it.***

NAME .....

ADDRESS .....

STATE .....

ELECTRO IMPORTING COMPANY,
231 Fulton St., New York City.

I enclose herewith 6 cents in stamps or coin for which please send me your latest Cyclopedia Catalog No. 21 containing 176 pages, 263 illustrations and diagrams, including Treatise on Wireless Telegraphy, and 20 coupons for your 160 page Free Wireless Course in 20 lessons.

ED-2-20

FILL IN THIS COUPON FOR YOUR COPY OF

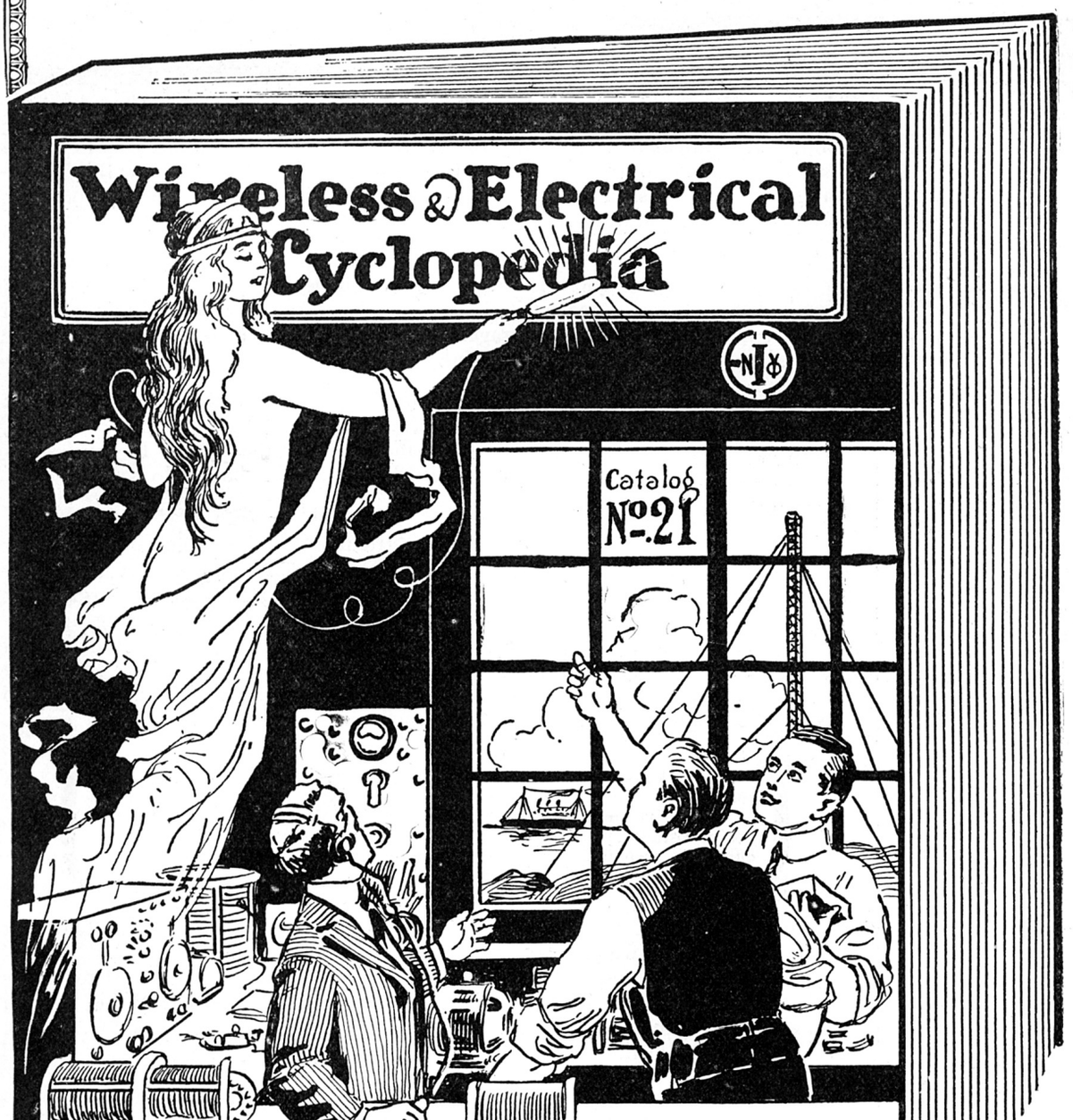
Our New 176 Page Cyclopedia No. 21

IT IS WAITING FOR YOU

Full size fac-simile of our catalog just as it looks when you get it

1-2 INCH THICK **WEIGHT ALMOST 1-2 POUND**

263 Illustrations



The Electro Importing Co.
231 FULTON STREET NEW YORK
"EVERYTHING FOR THE EXPERIMENTER"

A Few Interesting Things from Catalog No. 21

Treatise on Wireless Telegraphy by H. Gernsback, Editor **Electrical Experimenter** and **Radio Amateur News**—13 big pages, 3 illustrations.

The Wireless Law of 1912—all about it, what you can do and what you can't.

How to receive and send Radio messages.

How far you can send messages.

Table of wave lengths, of principal U. S. & foreign Radio high power stations.

How to receive time signals by Radio.

How to construct an amateur aerial.

How to use the test buzzer.

How to join the "Radio League of America" FREE, including application blank.

How telephone receivers are wound and built, tested and magnetized, 3 pages, 2 illustrations.

Experiments with a pony telephone receiver, with 6 illustrations.

Wireless Codes: Morse, Continental, Navy.

Experiments with spark coils, 3 pages.

How to photograph electrical discharges (sparks).

All about storage batteries, how to test them, recharging, etc.

Tesla experiments, 2 pages.

How to make Selenium Cells (illustrated).

FREE with this wonderful cyclopedia—20 coupons for our 160 page Wireless Course in 20 lessons. 350 illustrations, 30 tables. Catalog explains how you can get this Course absolutely free.

"THE LIVEST CATALOG IN AMERICA"

IN this cyclopedia you will find 116 pages all about radio. One of the greatest catalogs of its kind in print.

You will find in it dozens of wireless instruments of the famous E. I. Co. make. Remember always that this company was the FIRST to make and sell wireless instruments, the first wireless outfit having been placed upon the market by them in 1904. The E. I. Co. *knows how*, because it has the experience. Others imitate but cannot equal E. I. Co. for quality and workmanship.

Other things you will find listed in this catalog: Electrolytic Interrupters, Bulldog Spark Coils, Chemical Outfits, Omnigraphs, Code Practice Sets, Telegraph Instruments, Primary Batteries, Storage Batteries, Solenoids, Hydrometers, Volt and Ammeters, Batterymeters, Electrolytic Rectifiers, Rheostats, Tesla Coils, Nickel Plating Outfits, Lighting Plants, Dynamos and Motors, Microphones, Detectiphones, Loud Talkers, High Frequency Apparatus and supplies, Heating Pads, Electro-magnets, X-ray tubes, Telephones, Magnetos, Low Tension Transformers, Books, etc., etc.

IN A WORD THE MOST COMPLETE CATALOG IN PRINT

ELECTRO IMPORTING CO.
231 FULTON STREET NEW YORK, N. Y.

"Everything for the Experimenter"

WHAT I THINK OF PELMANISM—By George Creel

PELMANISM is the biggest thing that has come to the United States in many a year. With a record of 400,000 successes in England, this famous course in mind training has been Americanized, and is now operated by Americans in America for American men and women. Pelmanism is neither an experiment nor a theory. For twenty years it has been teaching people how to think; how to use fully the powers of which they are conscious; how to discover and to train the powers of which they have been unconscious. Pelmanism is merely the science of thinking; the science of putting right thought into successful action; the science of that mental team play that is the one true source of efficiency, the one master key that opens all doors to advancement.

I heard first of Pelmanism during a recent visit in London. Its matter filled pages in every paper and magazine and wherever one went there was talk of Pelmanism. "Are you a Pelmanist?" was a common question.

It was T. P. O'Connor who satisfied my curiosity and gave me facts. By 1918 there were 400,000 Pelmanists, figuring in every walk and condition of life. Lords and ladies of high degree, clerks and cooks, members of Parliament, laborers, clergymen and actors, farmers, lawyers, doctors, coal miners, soldiers and sailors, even generals and admirals, were all Pelmanizing and heads of great business houses were actually enrolling their entire staffs in the interest of larger efficiency.

Not a Mere Memory System

THE famous General Sir F. Maurice, describing it as a "system of mind drill based on scientific principles," urged its adoption by the army. General Sir Robert Baden-Powell and Admiral Lord Beresford indorsed it. In France, Flanders and Italy over 100,000 soldiers of the empire were taking Pelmanism in order to fit themselves for return to civil life, and many members of the American Expeditionary Force were following this example.

Well-known writers like Jerome K. Jerome, Sir Arthur Quiller-Couch, Max Pemberton, the Baroness Orczy and E. F. Benson were writing columns in interpretation of Pelmanism. Great editors like Sir William Robertson Nicoll and educators such as Sir James Yoxall were going so far as to suggest its inclusion in the British educational system.

As a matter of fact, the thing had all the force and sweep of a religion. It went deep into life, far down beneath all surface emotions, and bedded its roots in the very centers of individual being. A growing enthusiasm led me to study the plan in detail, and it is out of the deepest conviction that I make these flat statements:

Pelmanism *can,* and *does,* develop and strengthen such qualities as will-power, concentration, ambition, self-reliance, judgment and memory.

Pelmanism *can,* and *does,* substitute "I will" for "I wish" by curing mind-wandering and wool-gathering.

It is, and I say it advisedly, an important and necessary addition to American education, for it takes fundamental truths out of the back water and brings them back into real life and every-day use.

Pelmanism to-day is the *one* known course in applied psychology, the *one* course that builds mind as a physical instructor builds muscle. There is nothing really new in it. All of its truths are as old as the hills. But it reduces these truths to practical use. It puts them into harness for the doing of the day's work.

It teaches how to develop *personality,* how to build *character,* how to strengthen *individuality.* Instead of training memory alone, or will-power alone, or reasoning power alone, it recognizes the absolute interdependency of these powers and trains them *together.*

It is not, however, an educational machine for grinding out standardized brains, for it realizes that there are wide differences in the minds and problems of men. It develops *individual* mentality to its highest power.

GEORGE CREEL

There is nothing arduous about the course, and it offers no great difficulties, but it does require *application. Pelmanism has got to be worked at.*

There is no "magic" or "mystery" about it. It is not "learned in an evening." Brains are not evolved by miracles. Just as the arms stay weak, or grow flabby, when not used, so does an unexercised mind stay weak or grow flabby.

You can take a pill for a sluggish liver but all the patent medicines in the world can't help a sluggish mind. Pelmanism is not a "pill" system. It proceeds upon the scientific theory that there is no law in nature that condemns the human mind to permanent limitations. It develops the mental faculties by regular exercise, just as the athlete develops his muscles. It gives the mind a gymnasium to work in; it prescribes the work scientifically and skilled educators superintend the work. The "Little Gray Books" are intellectual dumbbells.

The Science of "Get There"

IT is the science of Get There—getting there quickly, surely, finely! Not for men alone, but for women as well. Women in commercial pursuits have the same problems to overcome as men. Women in the home are operating a business, a highly specialized, complex business, requiring every ounce of judgment, energy, self-reliance and quick decision that it is possible to develop.

I say deliberately, and with the deepest conviction, that Pelmanism *will* do what it promises to do. Followed honestly, it *will* give greater power of self-realization and self-expression in word, thought and action. It *will* stop wool-gathering and mind-wandering. It will develop mind, character, personality, giving ambition, energy, concentration and self-reliance.

There are too many men who are "old at forty"; too many people who complain about their "luck" when they fail; too many people without ambition or who have "lost their nerve"; too many "job cowards" living under the daily fear of being "fired."

Original thinking is almost a lost art. We look at games instead of playing them. The less the mental demand the more popular the play. There is music in restaurants because it is too much trouble to talk intelligently. Life is cut to pieces by deep ruts, with the people in them never looking over the sides. Greater driving force and higher powers of concentration will add to the nation's assets.

There is nothing more true than that success and failure are next-door neighbors. The success of today may be the failure of tomorrow, and the inefficient can rise to efficiency when he *wills* it. No one can mark time in modern life, much less stand still. We *go forward or drop back.*

Increased Incomes

TALK of quick and large salary raises suggests quackery, but I saw bundles of letters telling how Pelmanism had increased earning capacities from 20 to 200 per cent. With my own ears I heard the testimony of employers to this effect. Why not? Increased efficiency is *worth* more money. Aroused ambition, heightened energies refuse to let a man rest content with "well enough." Business demands ever-increasing efficiency and employers are quick to recognize it and reward it.

But Pelmanism is bigger than that. There's more to it than the making of money. It makes for a richer and more wholesome and more interesting life.

Too many people are mentally *lopsided,* knowing just the one thing or taking interest in only one thing. Of all living creatures they are the most deadly. I have seen eminent scholars who were the dullest of talkers; successful business men who knew nothing of literature, art or music; people of achievement sitting tongue-tied in a crowd while some fool held the floor; masters of industry ignorant of every social value; workers whose lives were drab because they did not know how to put color in them, and I have heard men and women of real intelligence forced to rely on anecdotes to keep up a conversation.

The emphasis of Pelmanism is on a *complete* personality. It does away with lopsided developments. *It points the way to cultural values as well as to material success.* It opens the windows of the mind to the voices of the world; it puts the stored wealth of memory at the service of the tongue; it burns away stupid diffidences by developing self-realization and self-expression; it makes unnecessary the stereotyped in speech and thought and action.

GEORGE CREEL

NOTE:—As Mr. Creel has pointed out, Pelmanism is neither an experiment nor a theory. It has stood the test of twenty years. Its students are in every country in the world. Its benefits are attested by hundreds of thousands of men and women in all walks and conditions of life.

Pelmanism is taught entirely by correspondence. There are twelve lessons—twelve "Little Gray Books." The course can be completed in three to twelve months, depending entirely upon the amount of time devoted to study. Half an hour daily will enable the student to finish in three months.

An ordinary school education is necessary, but of prime importance are sincerity of purpose and willingness to work.

How to Become a Pelmanist

"MIND AND MEMORY" is the name of the booklet which describes Pelmanism down to the last detail. It is fascinating in itself with its wealth of original thought and incisive observation. It has benefits of its own that will make the reader keep it. Every reader of this page should send for "Mind and Memory"—*Now.* It is free. Use the coupon or a postcard and send for it now—TO-DAY.

PELMAN INSTITUTE OF AMERICA
Suite 380, 505 Fifth Avenue, New York, N. Y.

PELMAN INSTITUTE OF AMERICA,
Suite 380, 505 Fifth Avenue,
New York, N. Y.

Please send me, without obligation, your free booklet, "Mind and Memory."

Name .....

Address .....

.....

All correspondence strictly confidential.
E. E. Feb.

How to take care of Dynamos and Motors.

All about the newest Wireless Apparatus.

How to wire Theatres and 'Movie Houses'.

All about the newest Electrical Appliances.

How to build small Motors and Generators.

All about the National Electrical Code.

A Thousand Things

Every day in your work you get up against new problems—sometimes it's only some old "sticker" coming in a new way. Just the same though it takes a lot of time to figure them out. *Don't do it.* Here's everything worked out for you. Every problem, big or little, that you will meet in a day's work. Hundreds of new ideas and better ways of doing things. Hundreds of ways the other fellows are making money. Hundreds of ways you can make more money out of the same work you are doing now.

Here Is What You Learn

Here are a 100 different subjects selected at random from the eight big volumns. This is just a small part of the total number of things explained. Several thousand propositions are treated.

How to Understand Underwriters Requirements.

How to run Alternators in parallel.

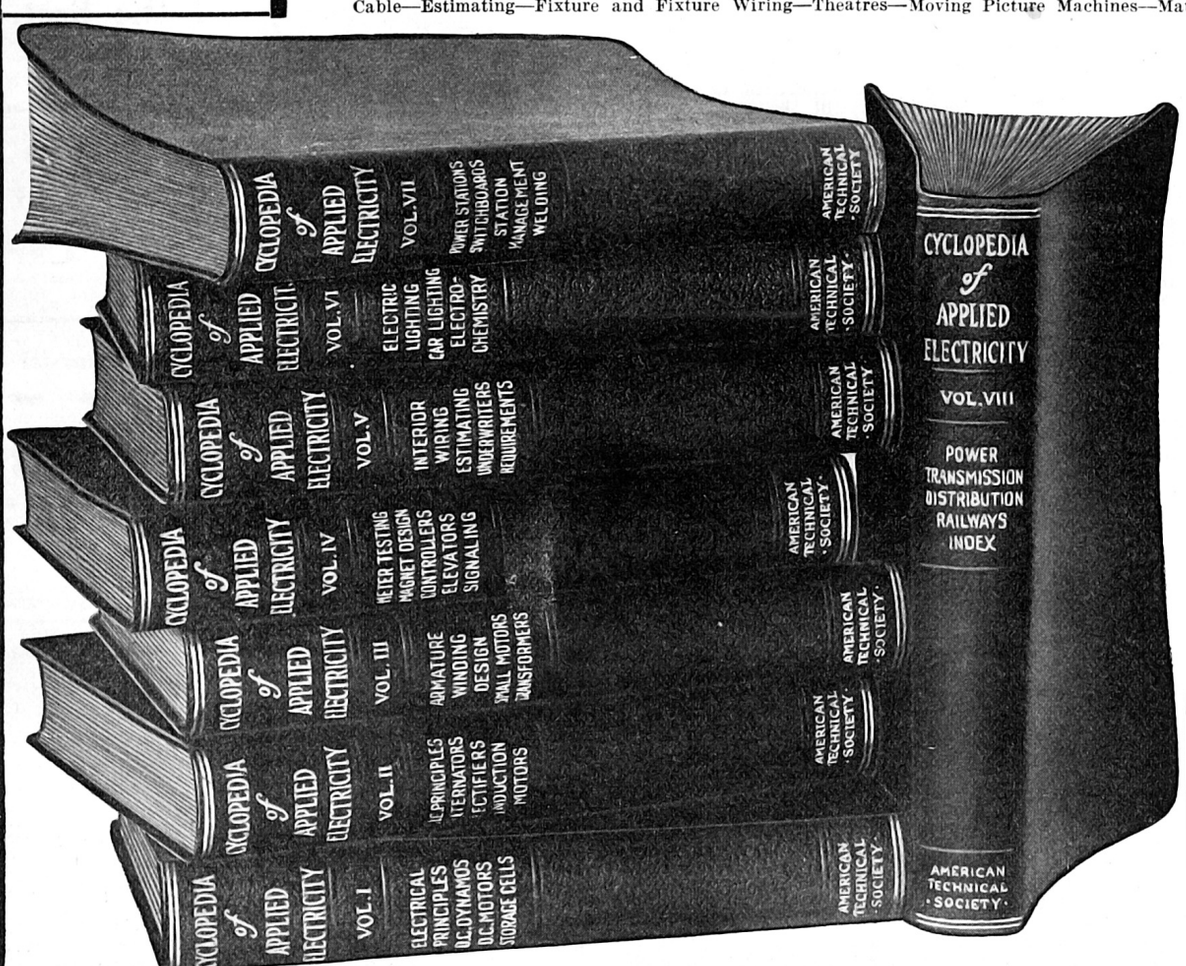
VOLUME I. **Elements of Electricity:** Magnetism—Static Electricity—Current Electricity—Battery Circuits—Electromagnets—Principles of Dynamos and Motors—Induction Coils—Telephone Principles. **Principles of D. C. Dynamos:** Field Magnets—Armatures—Voltage Regulation. **Principles of D. C. Motors:** Comparison with Generator—Operation—Design. **Storage Batteries:** Maintenance—Commercial Applications.

VOLUME II. **Alternating Current Machinery:** Instruments—Armature Windings—Regulation—Output—Tests—Commercial Types—A. C. to D. C. Current—Converters—Switchboards—Synchronizers.

VOLUME III. **D. C. Dynamo Design:** Efficiency—General Principles. **Armature Winding:** Calculations. **Design of Small Motors:** D. C. Design—A. C. Design—Induction Motor Design. **Transformers:** Operation—Efficiency Construction.

VOLUME IV. **Electrical Measurements and Meter Reading:** Instruments—Methods—Voltage—Current—Testing—Watt-Hour Meters. **Electromagnets and Induction Coils:** Design—Types. **Industrial Controllers:** Troubles—Automatic—Hand. **Electric Elevators:** Motor Design—Control—Transmission. **Railway Signaling:** Types.

VOLUME V. **Interior Electric Wiring:** Exposed—Knob and Tube Work—Wood Molding—Metal Molding—Conduit—Cable—Estimating—Fixture and Fixture Wiring—Theatres—Moving Picture Machines—Materials. **Underwriters Requirements:** National Electric Code — **Outside Wiring:** High-Tension Lines—Ground Circuits — Controlling and Protecting Devices.



VOLUME VI. **Electric Lighting:** Planning Systems — Cost — Estimating **Interior Lighting:** Offices Stores — Windows — Factories — Residences. **Exterior Lighting: Railway Car Lighting:** Material—Maintenance. **AppliedElectrochemistry:** Electric Furnaces—Metal Refining.

VOLUME VII. **Power Stations:** Cost—Equipment—Location. **Switchboards:** Wiring Diagrams — Connections. **Management of Dynamos and Motors:** Connection Diagrams—Operation—Trouble. **Electric Welding.**

VOLUME VIII. **Electric Transmission Lines:** Line Calculations — Voltage Regulations — Conductors — Construction—Insulation. **Distribution Systems:** Design of Circuits—Laying Out Systems—City and Country Distribution. **Electric Railways:** Motors — Trolleys — Car Wiring Systems—Mechanics. **Power Plants:** Construction, etc.

How to do Welding by Electricity.

How to estimate the cost of Electric Wiring.

How to Repair and charge Storage Batteries.

How to design and make Induction Coils.

How to determine the Proper size of Wire.

How to wire Residences and Apartments.

You Ought to Know

How to install Transformers.

The old days of hit-or-miss experience are passed. You have got to *know* if you want to keep in the running now. A little of your spare time and these great practical Electrical Books will put you 'way ahead of the rest. See our FREE TRIAL offer and easy payment plan below. Over 50,000 sets of these books have been sold. Thousands of men all over the U. S. have made good with them. Hundreds are making good every day. You can make good too.

The World's Greatest ELECTRICAL BOOKS

How to design and install Switchboards.

Eight great big volumes bound in genuine American morocco—flexible handy style. 3800 pages. More than 3000 blue-prints, plans, pictures and wiring diagrams. The newest, most complete, most practical electrical books ever published. Twenty-five well known electrical engineers and practical electricians prepared these great books, gathering the material from hundreds of different sources. Every man in the shop and on the job should have them.

How to select material and get the best.

FREE Examination

All about Railway Car Lighting.

Send the coupon for a set of Practical Applied Electricity today. You can't afford to be without them and you don't take any risk at all. The coupon brings the whole set of eight volumes (not a sample) by express collect for a whole week's free examination. Use the books just as you please and send them back to us within seven days if you feel you don't want to keep them.

No Money Down
Pay Only $2 a Week

If you do keep the books to help you in your work and help you make more money send us only $2.80. You can pay the balance of our special reduced price of $24.80 at the rate of $2.00 a month. Did you ever hear of a fairer selling offer than this—besides you save $15.20 because our regular price is $5.00 a volume. Send the coupon now and we will also give you a membership worth $12.00 in our society FREE.

American Technical Society, Dept. E-252 Chicago

All about Electrical Meters and how they work.

All about the latest in Electrical Heating.

How to make a Motor fool proof.

FREE TRIAL COUPON

American Technical Society,
Dept. E-252, Chicago.

Please send me the 8 volume set of Practical Applied Electricity, shipping charges collect. I will send you $2.80 in seven days and $2.00 each month until $24.80 is paid or return the books at your expense. If I buy the books I get a membership in your society free.

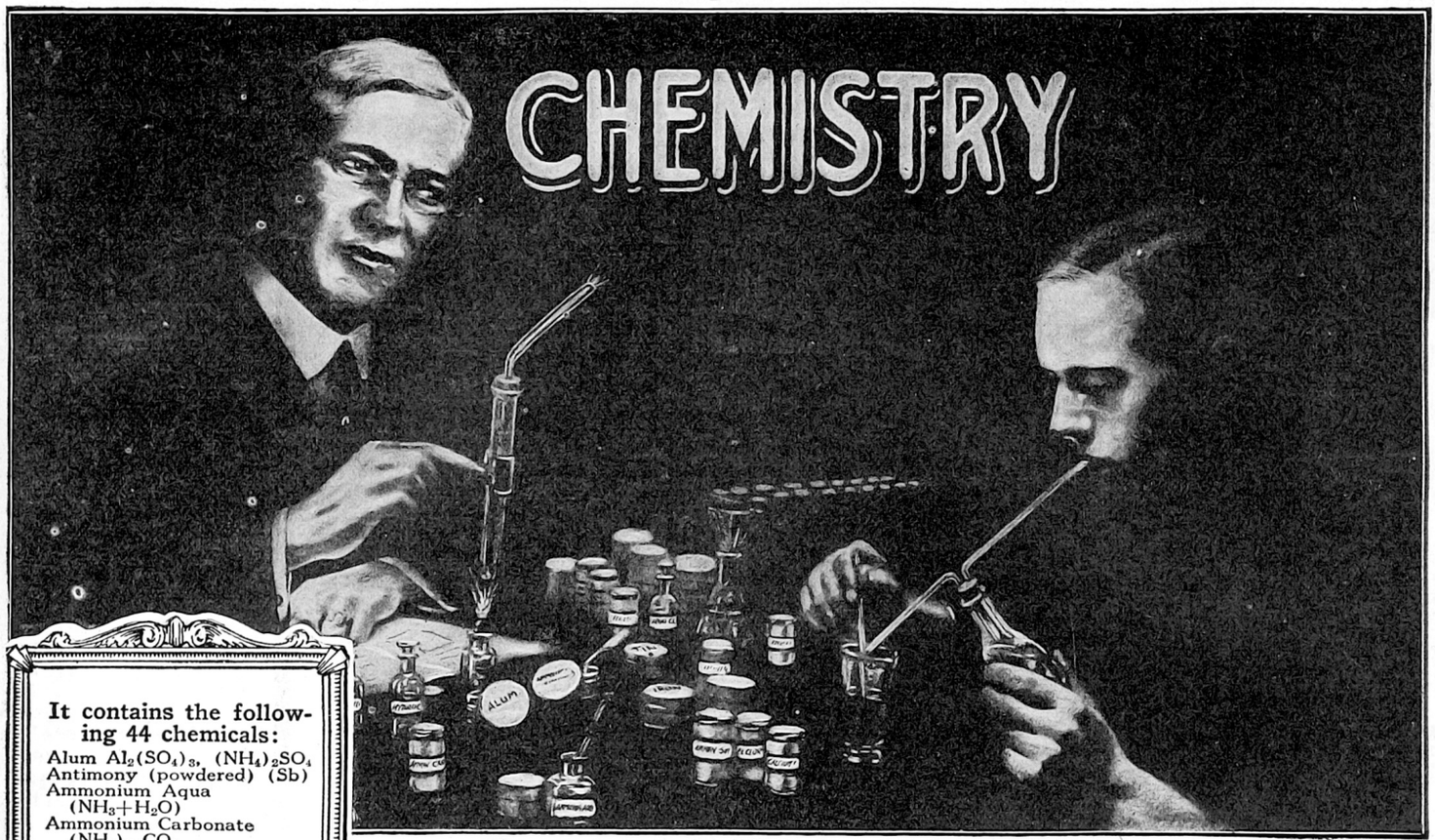
Name .....

Address .....

City..... State.....

Reference .....

Please fill out all of these lines.



"The Joy of Father and Boy."

Chemical Laboratory

We present herewith to our friends our new **E. I. Co. Chemical Laboratory** which contains **real** chemicals and apparata to perform **real** chemical experiments. This outfit is not a toy, put up merely to amuse, but a practical laboratory set, with all the chemicals, apparata and reagents necessary to perform real work and to teach the beginner all the secrets of inorganic chemistry. With this outfit we give free a book containing a **Treatise in Elementary Chemistry, useful data and recipes, and 100 instructive and amusing experiments.**

DESCRIPTION OF THE OUTFIT:

The outfit consists of forty-four (44) Chemicals all C. P. (chemical pure) put up in appropriate wooden boxes, glass bottles, and hermetically closed jars. The acids are put up in glass bottles, with ground-in glass stoppers and there is a sufficient quantity of chemicals supplied (mostly one to two ounces) enough to make dozens of experiments with each. See list of Chemicals herewith.

The apparata furnished are all of the best obtainable make and of standard laboratory size and shape. A list of the 17 pieces of apparata furnished with this outfit is printed also herewith.

The Instruction book is a real **Chemistry Course for the Beginner.** Some of the Contents are: **Division of Matter:** This is a Treatise on Elementary Chemistry and deals with the theory of the Elements, Molecules and Atoms, etc. **Chemical Nomenclature:** This explains in simple language the derivation of the chemical names of the Elements and their compounds. There is a chapter on **Laboratory Operations; Glass Working; First Aid; Fire Extinguishers; Experimenters' Aphorisms,** etc.

A good part of the book is devoted to Weights and Measures. The Metric System, the English system and the U. S. System are fully explained.

The following tables are furnished: Symbols and Atomic weights of the Elements; Measures of Weights, Volume, Capacity and Length; Per Cent solutions; Conversion of Measure expressed in parts; Poisons and their antidotes; Technical and common name of chemical substances; Formulas for Cleaning various substances, etc., etc.

Among the **100 Experiments** are:

How to make chemical tricks; How to make invisible and magic inks; How to test flour; How to test soil; How to Make Chlorine Gas and smoke (German War Gas); How to bleach cloth and flowers. How to produce Oxygen and Hydrogen; How to make chemical colors; How to test Acids and Alkalies and hundreds of interesting hints and formulas.

It contains the following 44 chemicals:

Alum $Al_2(SO_4)_3$, $(NH_4)_2SO_4$
Antimony (powdered) (Sb)
Ammonium Aqua (NH_3+H_2O)
Ammonium Carbonate $(NH_4)_2\ CO_3$
Ammonium Chloride (NH_4Cl)
Ammonium Sulphate $(NH_4)_2\ SO_4$
Barium Chloride ($BaCl_2$)
Boric Acid (H_3BO_3)
Brimstone (Sulphur) (S)
Calcium Chloride ($CaCl_2$)
Calcium Oxide (CaO)
Calcium Sulphate ($CaSO_4 2H_2O$)
Charcoal (Carbon) (C)
Chloride of Zinc ($ZnCl_2$)
Copper Sulphate ($CuSO_4$)
Ferrous Sulphate ($FeSO_4$)
Ferrous Sulphide (FeS)
Glycerol (Glycerine) $C_3H_5(OH)_3$
Hydrochloric Acid (HCl)
Iodine (I)
Iron Chloride ($FeCl_2$)
Iron Oxide (Fe_2O_3)
Lead Acetate Pb $(C_2H_3O_2)_2$
Litmus Paper
Magnesium Carbonate ($MgCO_3$)
Manganese Dioxide (MnO_2)
Mercury (Quicksilver) (Hg)
Nickel Chloride ($NiCl_2$)
Oxalic Acid ($H_2C_2O_4$)
Sodium Bicarbonate ($NaHCO_3$)
Sodium Borate ($NaBO_2$)
Sodium Carbonate (Na_2CO_3)
Sodium Chloride (NaCl)
Sodium Nitrate ($NaNO_3$)
Sodium Phosphate (Na_2HPO_4)
Sodium Sulphate (Na_2SO_4)
Sodium Sulphite (Na_2SO_3)
Stannous Chloride ($SnCl_2$)
Sulphate of Nickel ($NiSO_4$)
Sulphate of Zinc ($ZnSO_4$)
Sulphuric Acid (H_2SO_4)
Tin (Granulated) (Sn)
Zinc (Metal) (Zn)
Zinc Carbonate ($ZnCO_3$)

The following apparata are furnished:

One Standard Washbottle
One Alcohol Lamp
One Conical Glass Measure
One Erlenmeyer Flask
One Glass Funnel
One Delivery Tube
Six Assorted Test-Tubes
One Test-Tube Holder
Ten Sheets of Filter Paper
One Glass Dropper
One Spoon Measure
Glass Tubing
One book containing Treatise on Elementary Chemistry and 100 Chemical Experiments to be performed with this outfit.

The price is still $5.00. **Shipping Weight 10 lbs.** **(Can be shipped by Express only.)**

TRADE MARK **THE ELECTRO IMPORTING CO., Mfrs.** TRADE MARK
231 FULTON STREET NEW YORK CITY

"THE LIVIEST CATALOG IN AMERICA"

Our big, new electrical cyclopedia No. 21 is waiting for you. Positively the most complete Wireless and electrical catalog in print today. 176 Big Pages, 400 illustrations. 300 instruments and apparatus, etc. Big **"Treatise on Wireless Telegraphy."** 21 FREE coupons for our 160-page FREE Wireless Course in 20 lessons. FREE Cyclopedia No. 21 measures 7x5¼". Weight ½ lb. Beautiful stiff covers.

ELECTRO IMPORTING COMPANY
231 Fulton St., New York City

I enclose herewith 6 cents in stamps or coin, to cover postage, for which please send me your latest Cyclopedia Catalog No. 21 as described.

NAME .....
ADDRESS .....
STATE..... E.E. 2-20

How I Stopped Forgetting In One Evening

How in One Evening I Discovered the Secret of a Good Memory and in Six Months Increased My Business One Hundred Thousand Dollars

By William Gerard

WHO would ever have thought that a $100,000 increase in my business would come from a simple secret learned in one evening. And yet, that is just what happened. I look back on it today, and can hardly believe that it is only six short months since I learned from David M. Roth, the famous memory expert, how to make my memory do wonderful things that I never before dreamed possible.

I consider the evening I met Mr. Roth one of the most momentous in my life. It was at a dinner of the Seattle Rotary Club. Mr. Roth was present and started his exhibition by asking sixty of those present to introduce themselves to him by name. Then he requested a gentleman at the blackboard to write down names of firms, sentences and mottos on numbered squares, meanwhile sitting with his back to the writer. After this, he was asked by various Rotarians to tell what was written down in the specific squares. Mr. Roth gave the entire list without a mistake. After finishing with this, Mr. Roth singled out and called by name the sixty men to whom he had been introduced earlier, and who in the meantime had changed seats and mixed with others present.

After the meeting, I was introduced to Mr. Roth by a mutual friend, and congratulated him upon his marvelous feats of memory. To my surprise, Mr. Roth said, "Why, Mr. Gerard, such things are nothing at which to marvel. Anyone can do these things and even greater things with his memory. A good memory is not a gift. Any person of average intelligence can easily develop his memory. I, myself, am an example of this fact. As a young man my memory was so poor I could hardly remember a man's face or name 20 seconds. I soon realized that this bad memory would scare away any chance I had for success. Right then and there I determined to improve my memory. And now, after 20 years of attention to the subject, I feel that I can do as much for other people's memories as I have done for my own. I have recently finished work on a simple and practical course through which anyone can improve his memory until it becomes a veritable sponge for absorbing facts, faces, names and all the information one wants to remember. This course contains all of my secrets and principles. If you will write to my publishers in New York, the Independent Corporation, you can make arrangements for examining the course without charge."

Needless to say I wrote the Independent Corporation, asking to examine the course. In a few days I received the seven lessons together with a little booklet of letters from many men telling what they had already done through the aid of the course. It was very encouraging for me to read the letter from C. Louis Allen, who at the age of thirty-two became president of the million dollar Pyrene Manufacturing Company, and is now the president of the Sales Company bearing his name.

"Now (says Mr. Allen) that the Roth Memory Course is finished I want to tell you how much I have enjoyed the study of this most fascinating subject. Usually these courses involve a great deal of drudgery, but this has been nothing but pure pleasure all the way through. I have derived much benefit from taking the course of instruction and feel that I shall continue to strengthen my memory. That is the best part of it. I shall be glad of an opportunity to recommend your work to my friends."

You may be sure that after reading the balance of the letters telling of *real results,* I went right at the course that very evening. I expected to find the lessons "brain breakers", but to my surprise, the Roth Course was as easy and fascinating as a game. I hated to put it by that evening and surprised my wife by repeating backwards, forwards and all ways fifty words of all sorts. My wife could not understand how a person with a memory so poor as mine could do such a thing after only about one hour's study. But the course gives the secret of a good memory *right at the start.* I played the memory improving game for a few minutes each evening for a month. And the further I got the more fascinating the game became. Long before a month was up I had amazed my family and my friends on a number of occasions by various memory feats, and to them the astounding difference in my memory was nothing short of a miracle.

And now, my memory behaves so efficiently that my business has felt the impetus of my increased mind power and has responded in a joyously lucrative fashion. Within the last six months my sales have jumped up $100,000—*with no "war-baby" or external force to boost my business.*

The reason I know that my business expansion is due to my own increased power is that I seem to have a new grip upon affairs, I employ old facts and experiences, give them a new twist and have thereby revitalized my business methods. I now remember and apply all that I have heard other people have learned. Nothing slips my mind that can be used to some business advantage. I find and store in my new, iron-bound memory real nuggets of facts and experiences that other people casually let drop. When a condition arises, I just seem to open a certain drawer of my mind, then take out and marshal together all facts and precedents that I have learned. My memory has become an ally that never fails to help me push my business ahead "on high."

I now seize many golden opportunities that before would have slipped by and been out of reach by the time I woke up.

You see the Roth Course has done vastly more for me than merely teach me how to remember names and faces, telephone numbers, etc. It has done more than make me a more interesting talker. It has done more than give me confidence in myself.

Mr. Roth's Course has endowed me with new business perspective. It has made me a keener observer. It has given me a new sense of proportion and values. It has given me visualization—which after all is the true basis of business success.

I feel that I owe the Roth Memory Course a great debt—in fact, a $100,000 debt. I feel that telling my story to the readers of The Electrical Experimenter Magazine is only a small payment for what the course has done for me. Any power that can increase a man's business $100,000 and increase his mind power 90% deserves that man's sincere and truthful endorsement. I *know* that this is what the Roth Memory Course has done for me and for my business. Not alone am I happy to be able to tell my story as it happened, but I am gratified to know that anyone can do the same thing. A mere glance over the first lesson will show that there is a course, not for "high brows" who love to bathe in theory, but practical and easy instructions for every man, woman or child, who knows the enormous value of a good substantial memory. This same hand of mine that gave out $5 for the Roth Course took in $100,000 as a result, and in telling my experience, I feel that in a small way, I am repaying the great debt that I owe to the David M. Roth Memory Course.

William Gerard.

AMAZING MEMORY FEATS

Any man, woman or child of average intelligence can easily and quickly acquire a sure and exact memory.

When David M. Roth, the famous expert, first determined to cultivate his memory he did it because he had a poor memory. He actually could not remember a man's name twenty seconds. He forgot so many things, that he knew he could not succeed unless he did learn how to remember.

Today there are over ten thousand people in the United States whom Mr. Roth has met at different times—most of them only once—whom he can name instantly on sight. Mr. Roth can, and has, hundreds of times at dinners and lectures, asked from fifty to one hundred people to tell him their names and telephone numbers, and business connections, and then, after turning his back while they changed seats, has picked each one out by name and told him his telephone number and business.

These are only a few of the scores of other equally "impossible" things that Mr. Roth does—and yet a few years ago he could not remember a man's name twenty seconds. You too can do these wonderful things.

SEND NO MONEY

So confident is the Independent Corporation, the publishers of the Roth Memory Course, that once you have an opportunity to see in your own home how easy it is to double, yes triple your memory power in a few short hours, that they are willing to send the course on free examination.

Don't send any money. Merely mail the coupon or write a letter and the complete course will be sent, all charges prepaid, at once. If you are not entirely satisfied send it back any time within five days after you receive it and you will owe nothing. On the other hand, if you are as pleased as are the thousands of other men and women who have used the course, send only $5 in full payment. You take no risk and you have everything to gain, so mail the coupon or a letter now before this remarkable offer is withdrawn.

INDEPENDENT CORPORATION

Publishers of The Independent Weekly

Dept. R-1102 119 West 40th St., New York

Please send me the Roth Memory Course of seven lessons. I will either remail the course to you within five days after its receipt or send you $5 in full payment of the course.

Name .....

Address .....

El. Exp. 2-20

FOR SALE AT ALL NEWS STANDS

ARTISTIC TWO COLOR COVER

"THE 100% WIRELESS MAGAZINE"

What "Radio Amateur News" Is:

RADIO AMATEUR NEWS holds the field indisputably as the greatest radio magazine in print today. In point of circulation, number of articles, illustrations, RADIO AMATEUR NEWS now leads all other wireless magazines. The February issue with its sixty-four pages contains fifty-five separate purely radio articles and 130 illustrations. *Over thirty-eight thousand copies were printed and circulated.*

Each issue of the RADIO AMATEUR NEWS now contains 64 pages (or more) and an artistic cover in two colors. The illustrations average 130 every month and there are from 40 to 50 up-to-date articles, some by our biggest radio scientists, in every issue.

RADIO AMATEUR NEWS is the greatest and biggest radio magazine in print today.

RADIO AMATEUR NEWS is the only INDEPENDENT monthly wireless magazine in existence. It caters to no commercial interests—it has no boss save its readers. It is "different"—it has the latest radio news. It is a scientific magazine but it caters largely to the RADIO AMATEUR—it is by and for the Amateur. It is published by the publishers of the ELECTRICAL EXPERIMENTER, but there is no duplication of articles in the two magazines. Both are entirely different—but both together will give you ALL the radio news of all the world. Whether you are a professor or an Amateur, get a sample copy or order it from your Newsdealer today.

Partial CONTENTS OF FEBRUARY ISSUE:

The Super-Autodyne
By H. W. Houck

Radiophone Communication to and from Trains
By J. J. Graf

Modified Government Receptor
By J. Stanley Brown

Improvement in Buzzer Transmitters
By Edgar Terrain Johnstone

Banked Winding and How it is Done
By H. C. Silent

A New Type of Condenser for Selective Tuning
By E. M. Sargent

A New Receiving System
By Edward T. Jones, I.R.E.

Step Up Condenser
By John G. Merne, L.M.T.

The Priess Loop Set—Part 3
By Walter J. Henry

Junior Radio Section

$100.00 RADIOPHONE PRIZE CONTEST

The future of Radio lies in the Radio telephone, there is no doubt about that. With the Radiophone there is practically no interference; you need learn no code; a radiophone message takes but a fraction of the time of a radiotelegraph message.

The Editor of RADIO AMATEUR NEWS is so enthusiastic about the Radiophone, and he is such a staunch believer in its great future, that he has offered $100.00 IN GOLD for the best photographs and description of a good amateur Radiophone. Here is your chance for some easy money.

For full particulars see this month's issue of RADIO AMATEUR NEWS.

20c The Copy

$2.00 A Year

Canada and Foreign $2.50 A Year

SEND 20c FOR SAMPLE COPY TODAY

64 PAGES 130 ILLUSTRATIONS

SPECIAL OFFER

Gentlemen:

Please enter my subscription for RADIO AMATEUR NEWS for the term of one year for which I enclose herewith $2.00. As a special offer you will also send me for 25c extra your great Wireless Course containing 160 pages, 350 illustrations, size 6¾ x 10" with fine flexible cloth cover. I have written my name and address in margin below.

EXPERIMENTER PUB. CO., 231 Fulton St., New York City

LEARN WIRELESS By Mail—In Ten Weeks

Calls Coming in Steadily for National Radio Institute Graduates from All Parts of the Country. Four Concerns Guarantee to Take All Operators We Can Furnish.

Commercial Radio has arrived and many attractive positions are now open in the commercial land radio service, merchant marine, railroads, radio supply factories, lake and ocean steamship lines, telegraph companies and aerial mail service. We are now receiving requests for more National Radio Institute graduates than we can furnish.

Salaries Up to $350 a Month

with exceptional opportunity for promotion to Radio Mechanics, Electricians, Engineers, and Government Inspectors. No previous experience or training is necessary. You can learn Wireless the National Radio Institute way, in Ten Weeks, by mail, right in your own home. With our help you can quickly qualify for First Grade Government License and a good position paying you approximately $225 a month to start. Many of our students secure positions before completing the course, because it is based on actual practice and teaches what is needed to make a big success of Wireless work.

Get Your Instructions from the Nation's Capital

(Our Course is Endorsed by the United States Government Officials)

The National Radio Institute, established in 1914, was the first in America to successfully teach wireless by mail. It is headed by authorities who have been closely allied with government training of students. The work is under the direction of J. E. Smith, E. E., formerly director of the Radio Department, Howard University, and E. R. Haas, formerly of the Radio Division of Yale University, assisted by a competent corps of trained instructors and lecturers.

We now have hundreds of students throughout the world. Our location in the Nation's Capital, together with the standing of our officers and their wide acquaintance among government officials connected with Wireless activities, places us in position to give our students the best instructions obtainable and to be of the utmost help in assisting them to secure good paying positions.

Travel If You Want To

If you want to travel and see the world, go to foreign countries and increase your knowledge of world affairs, wireless offers you the chance of a life time. However, you are not obliged to travel, but may secure a permanent position at one of the many land radio offices, railroads, telegraph or steamship companies, if preferred.

Pay As You Learn

Our plans of payment places a wireless education within the reach of anyone who desires to learn.

A small payment down on our convenient payment plan and small following payments enables you to earn the cost of your tuition while actually learning to be a wireless operator.

FREE Instruments to Every Student

In addition to five text books—one hand book—46 special Lessons and 18 Personal Examinations—we send you, while taking our course, a Standard Automatic Transmitting and Receiving Set for sending and receiving messages. These fine instruments are sent only to National Radio Institute Students.

Free Membership in N. R. I. Relay League

Upon enrollment every student in the National Radio Institute is presented with a handsome blue and gold pin, signifying his official membership in the N. R. I. Relay League, with a rapidly growing membership throughout the world.

FREE Course in Radio Telephony

In addition to our complete course in radio telegraphy, every student is given our complete course in modern radio telephony. This course comprises ten special lessons and ten personal examinations. These combined courses enable our students to fill positions requiring thorough knowledge of both radio telegraphy and modern radio telephony.

Send the following coupon today for our FREE book containing all particulars and special offer to students enrolling now.

NATIONAL RADIO INSTITUTE
Dept. 169—14th and U Sts. N. W.
Washington, D. C.

Mail This Coupon Today

NATIONAL RADIO INSTITUTE
Department 169, 14th & U Sts. N. W.
Washington, D. C.

Send me, free of charge, your booklet, "Wireless The Opportunity of Today", with full particulars regarding your famous ten weeks' Home Study Course and your Special FREE INSTRUMENT OFFER.

Name .....

Address .....

City..... State.....

MAGAZINE Prices Slashed

Millions of magazine subscriptions expire this month! With the tremendous advance of paper prices and labor it is certain that nearly all magazines will advance their subscription prices at least from 25% to 50%.

BY ORDERING NOW YOU WILL SAVE BIG MONEY.

In announcing these wonderful prices it is with the absolute knowledge that our readers are offered the lowest prices for standard Magazines that it is possible to obtain anywhere. Only by special arrangement with the publishers are these prices possible, but to take advantage of them, you must act quickly. **Don't delay, do it now.** This offer is so good that of necessity it must be limited in time. Just think of buying standard Magazines at reduced prices in these times of high prices—just think what you can save on your reading matter for a whole year. Just glance over our wonderful prices, and see how we enable one dollar to bring you two dollars' worth, and then make up your list. When sending your order, don't forget to state where magazines are to be sent. But be sure you do it now. To-morrow means you may forget and lose this wonderful opportunity. All prices quoted are for subscribers in U. S. A. only, Canadian and Foreign subscriptions require additional postage.

The Publishers Will Mail the Magazine Direct From Their Own Office to You.

Electrical Experimenter	$2.50	Our Price	Electrical Experimenter	$2.50	Our Price	Electrical Experimenter	$2.50	Our Price	Electrical Experimenter	$2.50	Our Price
Popular Science	3.00	$5.00	Boy's Magazine	1.50	$3.50	McCall's Magazine	1.00	$3.00	Harper's Magazine	4.00	$5.50
Regular Price	$5.50		Regular Price	$4.00		Regular Price	$3.50		Regular Price	$6.50	
Electrical Experimenter	$2.50	Our Price	Electrical Experimenter	$2.50	Our Price	Electrical Experimenter	$2.50	Our Price	Electrical Experimenter	$2.50	Our Price
Scientific American	5.00	$6.75	World's Work	4.00	$4.75	Today's Housewife	1.00	$3.00	Boy's Life	2.00	$4.00
Regular Price	$7.50		Regular Price	$6.50		Regular Price	$3.50		Regular Price	$4.50	
Electrical Experimenter	$2.50	Our Price	Electrical Experimenter	$2.50	Our Price	Electrical Experimenter	$2.50	Our Price	Electrical Experimenter	$2.50	Our Price
Wireless Age	2.00	$5.75	Everybody's Magazine	2.00	$5.50	McCall's Magazine	1.00	$6.00	Farm Mechanics	1.00	$3.00
Radio Amateur News	2.00		Delineator	2.00		Review of Reviews	3.00		Regular Price	$3.50	
Regular Price	$6.50		Regular Price	$6.50		Regular Price	$6.50				
Electrical Experimenter	$2.50	Our Price	Electrical Experimenter	$2.50	Our Price	Electrical Experimenter	$2.50	Our Price	Electrical Experimenter	$2.50	Our Price
American Magazine	2.00	$5.50	Illustrated World	2.00	$4.00	St. Nicholas	3.00	$4.75	Field and Stream	2.00	$4.00
Woman's Home Companion	2.00		Regular Price	$4.50		Regular Price	$5.50		Regular Price	$4.50	
Regular Price	$6.50										
Electrical Experimenter	$2.50	Our Price									
Etude (for Music Lovers)	2.00	$4.00									
Regular Price	$4.50										

READ THESE OFFERS

Club No.	Magazine	Regular Price	With "E. E."
75	Aerial Age	$4.00	$5.50
55	American Gas Engineering Journal	3.00	4.50
50	Asia Magazine	3.00	5.00
35	**Boy's Life**	2.00	4.25
25	**Boy's Magazine**	1.50	3.75
60	Chemical & Metallurgical Engineering	3.00	4.75
40	**Christian Herald**	2.25	4.50
	Cosmopolitan	2.00	4.50
100	Country Life	5.00	7.50
60	**Current Opinion**	3.50	5.50
35	**Delineator**	2.00	4.25
28	**Designer**	1.50	3.90
35	**Everybody's**	2.00	4.25
25	Everyday Engineering	1.50	3.75
35	**Etude (For Music Lovers)**	2.00	4.25
35	Field & Stream	2.00	4.25
55	**Garden Magazine**	3.00	5.25
	Good Housekeeping	2.00	4.50
80	**Harper's Bazar**	4.00	6.50
70	Harper's Magazine	4.00	6.00
	Hearst's Magazine	2.00	4.50
35	**Illustrated World**	$2.00	$4.25
	Literary Digest	4.00	6.50
27	Modern Priscilla	1.50	3.85
	Motor	3.00	5.50
	Motor Boating	2.00	4.50
20	**McCall's Magazine**	1.00	3.50
45	**McClure's Magazine**	2.50	4.75
70	**Outing**	4.00	6.00
20	Pathfinder	1.00	3.50
20	People's Home Journal	1.00	3.50
55	Physical Culture	3.00	5.25
40	**Pictorial Review**	2.00	4.50
70	Popular Astronomy	3.50	5.25
60	**Popular Science**	3.00	5.00
25	**Radio Amateur News**	2.00	4.00
50	**St. Nicholas**	3.00	5.00
95	Scientific American	5.00	6.75
60	System	3.00	5.50
15	**Today's Housewife**	1.00	3.35
35	**Wireless Age**	2.00	4.00
17	**Woman's Magazine**	1.00	3.35
60	**World's Work**	4.00	5.50
50	**Youth's Companion**	2.50	5.00

For computing together Magazines listed separately, add Class Numbers before title and multiply by 5, giving our price to you in dollars and cents.

Write for Special Prices on ANY Publication not listed here

We will save you money

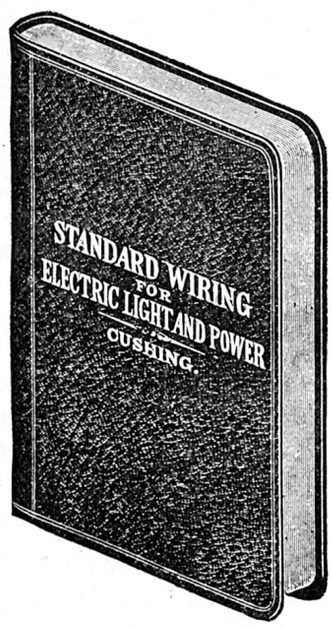
SEND ALL ORDERS TO "CIRCULATION DEPARTMENT"

EXPERIMENTER PUBLISHING CO., Inc.

233 Fulton Street, New York City, N. Y.

LEARN WIRING

Earn $50.00 to $75.00 a Week



POCKET SIZE
LEATHER COVER

This Latest Edition of "STANDARD WIRING"

Will Make You An Expert Wireman

GENERATORS—How to install them, care for them and operate them; all their troubles and how to prevent and cure them; all diagrams showing connections for compound, series and shunt wound machines. How to operate them in parallel or in series. How to protect them and wire them in accordance with the 'underwriters' requirements.

MOTORS—How to install them, how to protect and operate them. The required amperes, volts or horse power when any two factors are known. How to take care of hot boxes, sparking commutators and other troubles. How to change the direction of rotation when desired. How to start and stop any kind of motor in any class of service. All diagrams of motor wiring. How to find the proper size of wire for any motor for direct current or for A. C. single, two or three-phase.

OUTSIDE WIRING—Pole line construction, line wires, service wires, roof structures, poles and their dimensions and weights, and how to erect and protect them and wires they carry. Insulators, guard arms, guy anchors. Tree wiring, splicing, service and entrance wiring. How to install Lightning arresters. Transformers with diagrams and instructions.

INSIDE WIRING—When and where to use rubber covered, slow burning and weatherproof wire. How to find the proper size of wire to use for lamps, motors or heating devices for any current, voltage and drop, either by formula or by the many tables that are given in this section of the book. How to wire for two-wire or three-wire systems. Direct current, two-phase and three-phase with formulae and tables, with examples worked out for each system and in a simple manner that anyone can understand and use. How to run wires on walls, ceilings, floors, through partitions and walls and in concealed places, damp places and where dangerous surroundings exist. When and where to install Switches, Cut-outs and Circuit Breakers and just how to do it. How to wire for high and low voltage systems and the precautions to be taken. The proper way to install Knife and Snap Switches, Cabinets and Cut-out Boxes, Outlet, Junction and Switch Boxes, Panel Boards, Wooden and Metal Raceways. How to install complete interior conduit jobs either for rigid metal, flexible metal or flexible non-metallic conduit. Concealed knob and tube work or armored cable. How and where to install and wire electric and combination lighting fixtures. How and where to use flexible cord and where not to use it. How to install arc lamps and gas filled lamps and the fixtures and rules required.

LIGHT AND ILLUMINATION—What is meant by proper and efficient illumination, the latest data on Mazda and gas filled lamps of every candle power and wattage. Direct, indirect and semi-indirect illumination and where each should be used. Illumination required for various classes of service from show window lighting to public halls and from factories to small residences.

TABLES—Fifty-two tables giving every dimension, carrying capacity, resistance, weight and strength of every size of wire and cable of copper, steel and iron.

All the necessary dimensions, capacities, weights, and other data on conduits, fuses, insulators, lamps, sockets, motor efficiencies, current per horse power of motors.

Electrical units and their equivalents. Proper size of wire for all classes of power, light and heating installations. The proper symbols to use to indicate on plans just what is wanted from a motor to a small snap switch with all necessary diagrams.

APPARATUS AND SUPPLIES—A classified list of the leading manufacturers of officially approved wires and wiring devices. Engines, generators, motors, appliances, fixtures, and all supplies necessary for any complete installation from a Central Station to a small cottage.

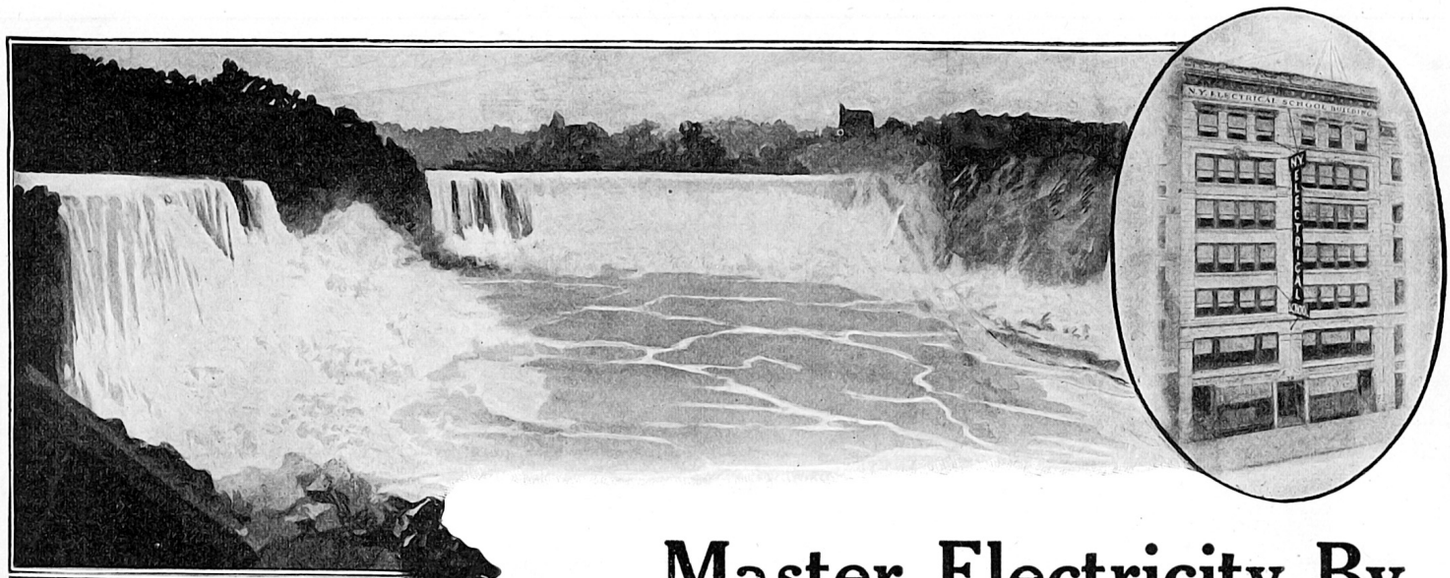
The most complete and accurate Book on Wiring and Construction published

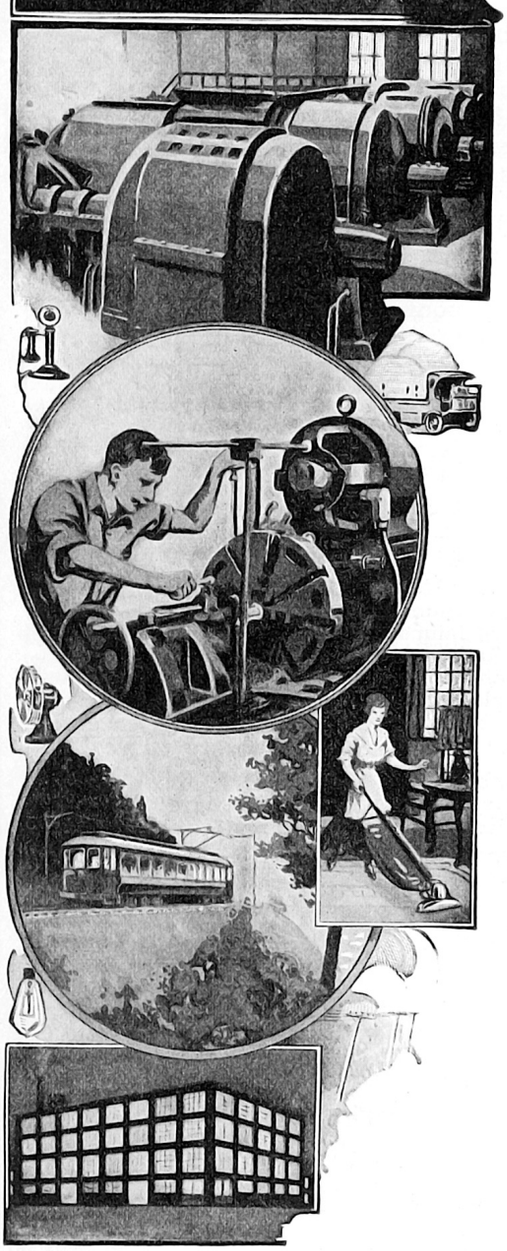
350 PAGES - LEATHER COVER - POCKET SIZE, $1.50

Sent Postpaid to Any Address on Receipt of Price by

H. C. CUSHING, Jr., 10 West 40th St., New York

Every Electrical Inspector in the United States will approve your work if done in accordance with the simple rules given in "Standard Wiring"





Master Electricity By Actual Practice

The only way you can become an expert is by doing the very work under competent instructors, which you will be called upon to do later on. In other words, *learn by doing.* That is the method of the New York Electrical School.

Five minutes of actual practice properly directed is worth more to a man than years and years of book study. Indeed, Actual Practice is the only training of value, and graduates of New York Electrical School have proved themselves to be the only men that are fully qualified to satisfy EVERY demand of the Electrical Profession.

The Only Institution of the Kind in America

At this "Learn by Doing" School a man acquires the art of Electrical Drafting; the best business method and experience in Electrical Contracting, together with the skill to install, operate and maintain all systems for producing, transmitting and using electricity. A school for Old and Young. Individual instruction.

Over 6,200 Graduates are Successful Men in the Electrical World

No previous knowledge of electricity, mechanics or mathematics is necessary to take this electrical course. You can begin the course now and by steady application prepare yourself in a short time. You will be taught by practical electrical experts with actual apparatus, under actual conditions.

The N. Y. E. S. gives a special Automobile Ignition Course as an advanced training for Auto Mechanics, Garage Men and Car Owners. The course covers completely all Systems of Ignition, Starters, Lighting and other electrical equipment on automobiles, motor boats, airplanes, etc.

Let us explain our complete courses to you in person. If you can't call, send now for 64-page book—it's FREE to you.

New York Electrical School
29 W. 17th St., New York, N. Y.

Please send FREE and without obligation to me your 64-page book.

..... NAME
..... STREET
.....CITY .....STATE

New York Electrical School

29 West 17th Street, New York

ELECTRICAL EXPERIMENTER

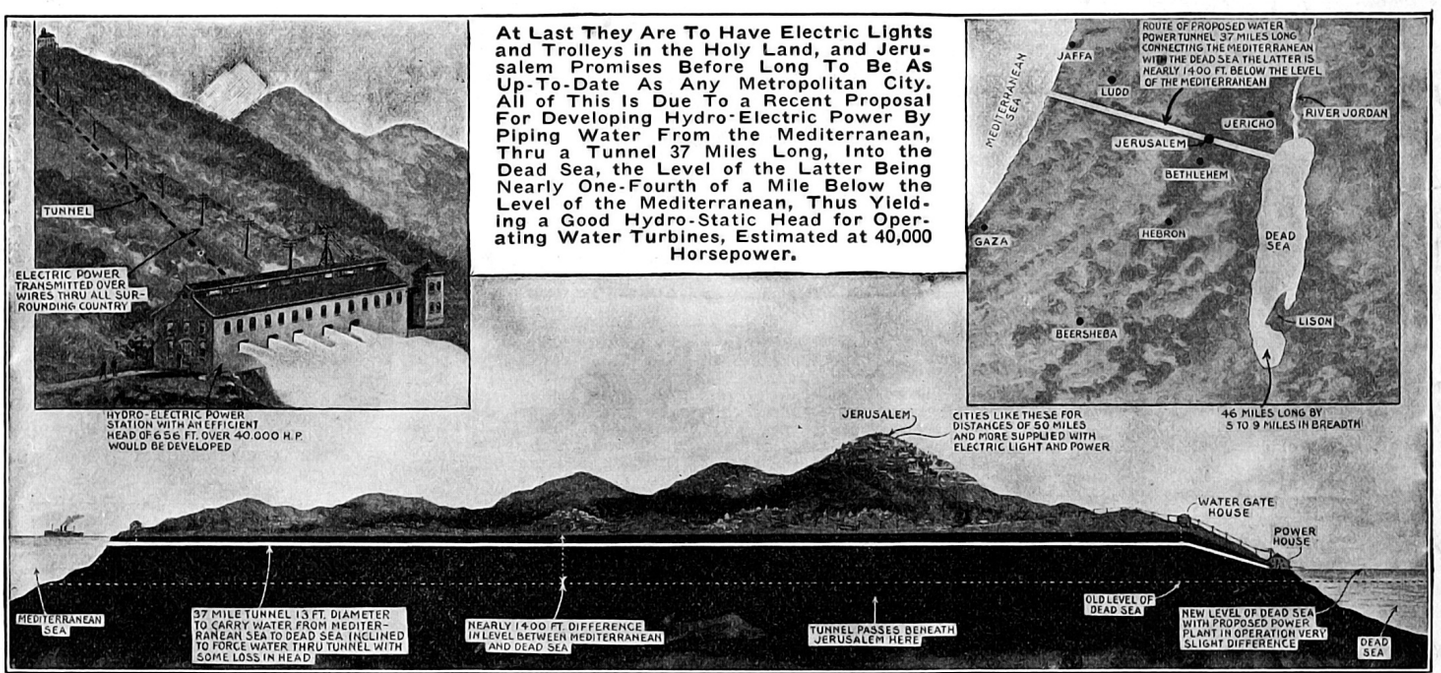
H. GERNSBACK – EDITOR
H. W. SECOR – ASSOCIATE EDITOR

Vol. VII. Whole No. 82 February, 1920 No. 10

Electrifying The Holy Land

By Piping Water From The Mediterranean Into The Dead Sea

THE latest news in international engineering circles is to the effect that a Norwegian engineer, Mr. Albert Hjorth, has perfected a bold yet comprehensive plan for electrifying the "Holy Land." He proposes, for one thing, to pipe water, hundreds of thousands of gallons of it, from the Mediterranean Sea into the Dead Sea, which latter is nearly 1,400 feet below the level of the former.



At Last They Are To Have Electric Lights and Trolleys in the Holy Land, and Jerusalem Promises Before Long To Be As Up-To-Date As Any Metropolitan City. All of This Is Due To a Recent Proposal For Developing Hydro-Electric Power By Piping Water From the Mediterranean, Thru a Tunnel 37 Miles Long, Into the Dead Sea, the Level of the Latter Being Nearly One-Fourth of a Mile Below the Level of the Mediterranean, Thus Yielding a Good Hydro-Static Head for Operating Water Turbines, Estimated at 40,000 Horsepower.

Copyright, 1920, by E. P. Co.

WHAT IS THE DEAD SEA?

The so-called "Dead Sea" is the largest lake in Palestine, and physically as well as historically is among the most remarkable in the world. The sea is forty-six miles long, and varies from five to nine in breadth. Its bed is the lowest part of the great valley of the Jordan; and its surface has a depression of no less than 1,367 feet beneath the level of the ocean (and also the Mediterranean). The Jordan Valley itself, for a distance of about eighty miles to the northward and thirty to the southward, is also below the level of the ocean. The general contour of the sea is an elongated oval, with a number of bold promontories and deep bays along the western shore, and a large, low peninsula on the southwest. It is shut in on the east and west by parallel ranges of mountains which rise steeply, and in some places in precipices of naked rock, from the water. The water is intensely salt and bitter, and its density is so great that the human body will not sink in it. Its specific gravity is 1.277.

A GIGANTIC TUNNEL 37 MILES LONG.

This plan for developing hydro-electric energy in the Palestine involves the building of a great tunnel, 37 miles in length, passing along the route shown in the accompanying map. A writer on this interesting engineering venture in the *Evening Post*, of New York, outlines the following proposals and data:

Great importance attaches to the sensational project brought forward by Mr. Albert Hjorth, a Norwegian civil engineer, which utilizes the level variation between the Mediterranean and the Dead Sea, by means of great power stations. These plans are the result of a thoro study of the meteorological, climatic and geological conditions of the country, which made it obvious that practically the only possibility for a new agriculture lies in an efficient irrigation.

Mr. Hjorth's plan proposes a tunnel about *thirty-seven miles long*, running west to east from the Mediterranean to the Dead Sea, *passing under Jerusalem*. The tunnel would carry the water from the Mediterranean to the western slopes of the lower end of the Jordan Valley. From this point the water would be directed thru pipes down to the level of the Dead Sea, where a power plant with turbo electric machinery would transform the water power into electricity, to be distributed as light and power thruout the country, and drive a pumping plant at the southern end of the Lake of Genezareth.

The level of the Dead Sea is about 1,367 feet below sea level, that of the Lake of Genezareth about 656 feet below sea level. Preliminary estimates show that tens of thousands of horsepower may be developed thruout the year in this manner, by means of a tunnel of 135 square feet cross-section, or about 13 feet in diameter, carrying twenty tons of water a second. The rise of the Dead Sea caused by this would not be more than a fraction of a yard a year. The surface of the Dead Sea, which is now about four thousand square miles, would be allowed to increase as much as the increased

(*Continued on page* 1058)

Sub-Sea Exploration

By JOSEPH H. KRAUS

Seeing and Working Under Water By New Invention

MAN'S combined achievements with the forces of nature and the annihilation of space with regard to the earth, the air, and on the ocean have been startling to the extreme, and yet how strikingly is this contrasted with his knowledge and achievements with those forces undersea. From the beginning, on down thru the ages—before ships started to sail, men always wondered what was down there beneath the surface of the ocean; what immense wealth in quantities never realized, lie down there, which offer the greatest, most promising opportunities for investment, aggrandizement and fame.

Practically speaking, all this sunken wealth, including hundreds of thousands of ships which have gone down since the first ship sailed the high seas, (in the days when the Pirates and Buccaneers were waging continual wars, and sailing around in gold-laden vessels)—from that period until the present war, thousands more with their cargoes of mails, treasures, furnishings, machinery, and equipments totalling untold wealth were sunk.

They are still lying down there, in spite of man's best ingenuity, daring, energy, and persistency, because all attempts to reach these depths were barred and *practical results* were limited to a depth of about 100 ft.

Our readers have since the war seen various and numerous descriptions and illustrations in both scientific journals and the press, explaining the manner in which ships and other treasures sunk beneath the waters will *probably be refloated* and how the treasures may be recovered. Those same ships and treasures are still down there, resting calmly, with no one to molest the secrecy of their holds. It is not even necessary to attempt to pry them open as they are there awaiting the taking, if some human being would only go down and salvage them.

The object of this article is to make the subject of sub-sea work comprehensive in its entirety. The human body has been made the frail object of resistance between the forces of nature (air and water pressure) to the limit of endurance, and any authentic records will show that limit to be about 100 ft. depth for producing anything like practical results. This is admitted inasmuch as the means hitherto available have not even scratched the surface, in an attempt to get into the depths where wealth and glory are to be found in abundance.

The new method which is of intense interest at this time has been employed successfully for a number of years. This is the sub-sea flexible tube apparatus invented by Captain Charles Williamson and holds sway over all means hitherto tried. It is not alone sufficient to say that the apparatus in question has proven to be of actual commercial value, but also comments on its basic ideas and principles have never shown any fallacy to exist, nor have any of the many distinguisht authorities who have witnest its action, had aught but praise for it. Captain Williamson, a man advanced in years, but with the alacrity of a most agile youth, a pleasing countenance, and a youthful sparkle in his eyes, explained some of the possibilities and results to the writer. Many of these results are well known, some having been accomplisht by his two sons, Ernest and George, who formed a subsidiary corporation to operate under the patents of their father's corporation. They have thus been able to place before the world, many of the hidden wonders of the undersea. Underwater photography has become an establisht fact, and until one has seen the wonderful moving picture submarine scenes in the Williamson Brothers' picturization of the eternal novel of Jules Verne's—"20,000 Leagues Under the Sea"—one fails in his attempt to compute the future possibilities of this invention. This together with "The Williamson Submarine Expedition" and other well known Williamson productions, constitute but a small fraction, a minute particle of the work which the original apparatus now makes possible.

The Williamson tube apparatus construction is built in segments, each segment in turn making up units. The units are of any desired length, and made to withstand water pressure even greater than exists in the deepest oceans, according to the opinion voiced by one of the highest scientific authorities in the country. Each unit is so arranged that if it were sealed up at both ends it would displace a volume of water equal to its own weight, and placed in water, it would float "awash"—that is to say, on a level with the surface of the water. The circumferential wall of this unit is made collapsible, and so arranged that metallic interlocking segments permit such action freely. These are mounted on suitable annular frames, which maintain a constant diameter and permit the passage of workers as desired. A number of these units make up sections 10 or more feet long and the section again is only one of the parts of the tube apparatus.

The entire length of tube has at the bottom an operating chamber, which chamber is specific for each different purpose and intention. In nearly all of them if the operator must work on outside objects, there is a steel glove into which the operator's hand finds easy access. This glove prevents the terrific pressure at great depths from crushing completely the bones in the human body. The only portion of the operator, therefore, which is subject to pressure, and very little of that, is that portion which extends in the glove.

Now as to the method of submerging the tube apparatus itself. As has been stated before, each section of the tube is made so that it can be sealed at the bottom by means of the operating chamber. This operating chamber is clampt by hatch-hooks or massive bolts to the sections of tubing and the sections of tube are likewise clampt together. These sections will float awash, due to the well known physical law. (Note 35 cubic feet of water weigh one ton.) If we take one ton of iron and from this one ton of iron make a body which will have a capacity of thirty-five cubic feet, and place the same in water, the upward pressure of the water against the body is equal to or slightly greater than its own weight, and the body floats practically awash. Should now a vessel, weighing one ton and having a displacement of seventy cubic feet, be placed in water, it would sink to a depth of only one half the original depth, in other words, half of the body would be out of the water, and that is exactly one of the principles this tube is based on.

The apparatus is brought to the point of operation with only the operating chamber riding along in the water. A section of the tube is bolted to the operating chamber and the operating chamber is released. Immediately it sinks due to the extra weight placed upon it, until again a level of equilibrium is reached. Thus the top of the tube will again be practically awash and another section is bolted in place and so on ad infinitum, until the desired depth is reached. Tools, etc. are operated thru the chamber by means of air tight joints and may be reached at, and set into drills, etc. thru a tool air-lock and clampt into position from the outside via the iron glove. A passageway is permitted thru the tubes into the operating chamber at all times.

The operator in the Williamson sub-sea device is at all times free to work under normal atmospheric conditions.

Several of the more useful applications for this industrial sub-sea exploring apparatus are illustrated herewith, but Captain Williamson states that the greatest revelation of all is still to come.

In applying this apparatus, for inspection and minor repairs, to the hulls of vessels as depicted in scene No. 2, it will be seen how easily an operator can use ordinary pneumatic tools without the necessity of purchasing special apparatus. Imagine if you can, the number of vessels which are being daily dry-docked for minor repairs which can now be made from an apparatus of this character, without the necessity of laying up the ship. This is only one of the many applications. The sides of the ship can be cleared of their growth of barna-

(*Continued on page* 1074)

TO OUR READERS

WITH this issue the price of the ELECTRICAL EXPERIMENTER advances to 25c a copy, $2.50 a year in U. S. and $3.00 Canada and foreign.

The old price of 20c has been in force since November, 1918, and our readers need not be reminded of all the price increases since that time. During the past year many commodities have doubled in price. The price of paper has increased 40% over the price in 1918. The cost of printing has gone up 35%. Engravings and art work increased over 50% in price. Salaries have advanced over 40%. Still in raising the price from 20c to 25c we have only burdened you with an increase of 25%. And if you take into consideration that we have added over 36 pure text pages to the magazine since November, 1918 (this issue has been increased eight pages again), you can readily see that your increase of 25% is really very small. In other words, the advertiser pays twice the increase in price you are asked to pay.

Frankly, we dislike a 25c magazine. It is bad business for us, as it may check the rapid growth in circulation that we have shown during the past year.

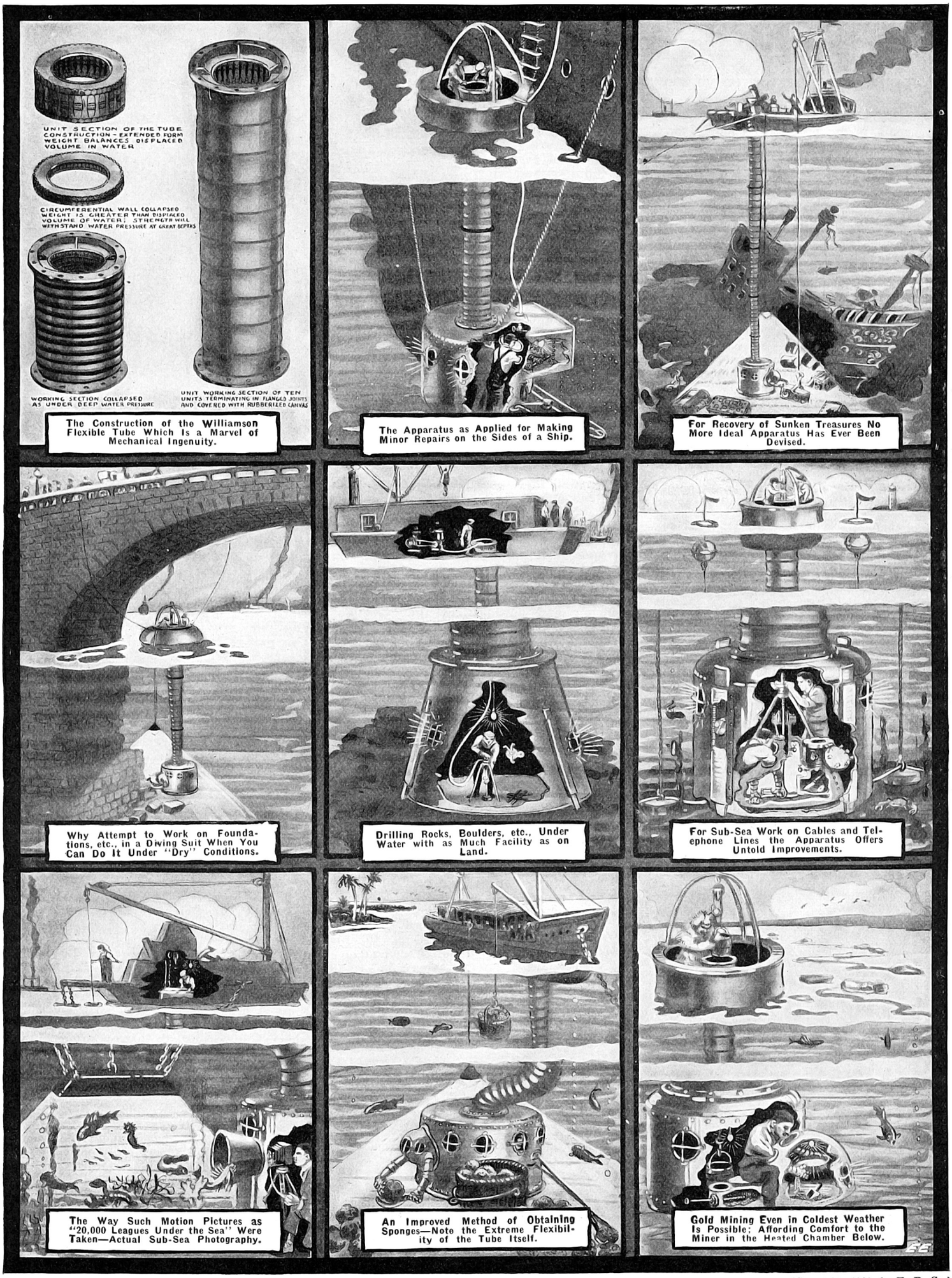
But we cannot publish at a loss, and we refuse to print a 72-page magazine now, after having built up the greatest periodical of the kind ever publisht.

Mr. Gernsback has had dreams of a circulation of 500,000 copies (this issue numbers 175,000 copies)—but this cannot be done at 25c a piece. Some day when conditions are normal once more we hope to come down to 15c again.

Until that day won't you bear with us and remember that we make less—much less—now than when the price was 15c.

THE PUBLISHERS.

THE SUB-SEA EXPLORER



(Copyright, 1920, by E. P. Co.)

The Goddard Moon Rocket

SPECIAL AUTHORIZED INTERVIEW WITH THE INVENTOR

EVER since Jules Verne, we have read many proposed schemes how to send projectiles with or without occupants to the moon and to the different planets, but nothing has so startled the world as the recent investigations of Dr. Robert H. Goddard, Professor of Physics of Clark College. This savant has not merely theorized on his invention but has spent years of energetic investigations which prove conclusively and beyond doubt the possibility of building a rocket which could ascend to our nearest satellite, the moon. The description of his apparatus and some of the findings are given in the accompanying article.

There is not the slightest doubt but that a rocket of this nature, or an apparatus of sufficient size would be able to land on the dark side of our satellite. If Dr. Goddard's rocket carried sufficient flash powder its presence could make itself ascertained thru some of the powerful telescopes, which we at the present day, are using. It will not be necessary either to wait many days for any such result. Inasmuch as actual tests have clearly demonstrated the speed of the rocket can be in excess of 230 miles in less than six and a half minutes, the distance of 220,000 miles intervening could be bridged in less than 100 hours.

It is astonishing to note the relatively small initial powder charge necessary to propel a weight of one pound to an infinite altitude, provided of course that the efficiency of the rocket itself is high, the gases that are ejected having an effective velocity of 7,000 feet per second, giving an increase in speed of a hundred and fifty feet per second. Such a rocket requires only 612 pounds of initial mass. How enormous, however, must this initial mass become if we have poor efficiency as found in present day rockets? Suppose that instead of 7,000 feet per second, we had a rocket having velocity of the ejected gases of only 3,500 feet per second. Its initial mass even at starting would then have to be 351,000 pounds. From these figures, it will be seen that if we have an apparatus all set up for sending the rocket to the moon, or further than to the moon, even out to infinity, and the rocket was to travel at 7,000 feet per second, as in actual tests made upon it, we would only require 602 *pounds for every pound that is to be sent to infinity.* Now surely, it does not seem at all improbable that we could build a rocket which would weigh 602 pounds. Furthermore, if this rocket should be filled with flash powder which were exploded automatically upon reaching the dark surface of the moon, it could be observed by the aid of a telescope having a one-foot aperture.

Two and three-quarters pounds of flash powder would be just visible and 13 pounds would be strikingly visible, according to Dr. Goddard. It would be a wonderful experiment to watch this rocket ascend to the moon, and illuminate a small spot on its dark side.

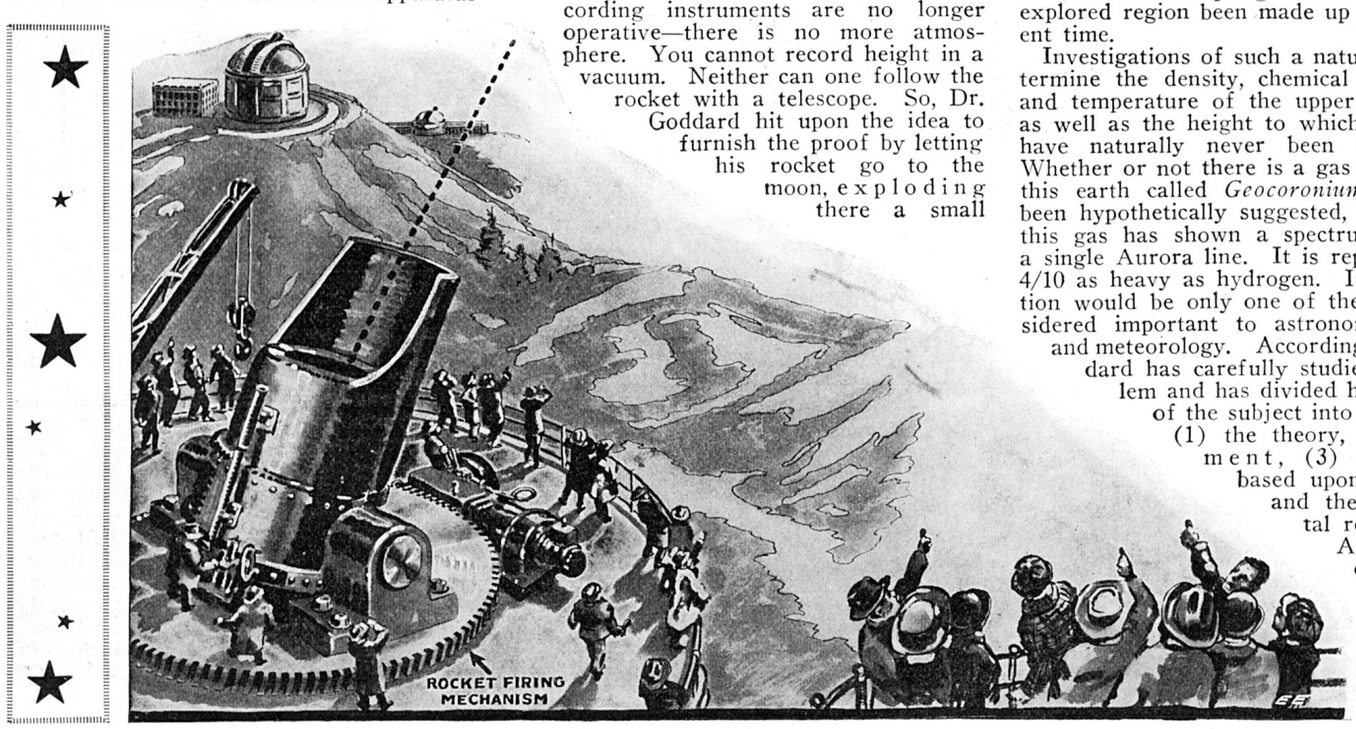
It is for the reason that many people have obtained mistaken conceptions of the principle and purposes of the "Goddard Rocket," that this publication attempts to place it before our readers in as clear and concise a manner as possible, together with its possibilities and results.

Dr. Goddard did NOT start out to build a machine to fly to the moon. He wanted to perfect an apparatus capable of reaching high altitudes of our own atmosphere, in order to explore its many mysteries. The idea of the Professor's rocket landing on the moon was only incidental and came up during his researches. For, once the rocket would reach beyond only 300 miles it would be impossible to prove that it had ascended so high, for at such a height recording instruments are no longer operative—there is no more atmosphere. You cannot record height in a vacuum. Neither can one follow the rocket with a telescope. So, Dr. Goddard hit upon the idea to furnish the proof by letting his rocket go to the moon, exploding there a small charge of flash powder. The effect could then be seen from the earth. That surely would be proof sufficient.

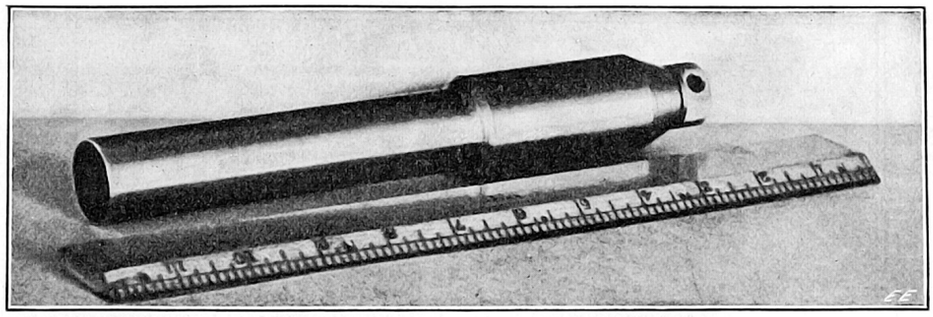
In the past an attempt to reach altitudes of 20 miles or over has been very problematical and doubtful, and only slight enthusiasm was aroused on this subject when the first report and the theoretical and experimental data were submitted to the Smithsonian Institution in 1916 by Dr. Goddard. Sufficient interest, however, by the Institution to set aside $5,000 for future developments caused the inventor to work with zeal and seldomly permitted any publicity of the subject. However, now that the rocket is well under way, and things are running along smoothly, Dr. Goddard thinks that it is well that the world should know more about the apparata which had been used in conducting the experiments and data, and learn something of the results he has obtained. The altitude of 20 miles, as we have said, is a maximum to which sounding balloons have been sent, altho the atmosphere of the earth extends to a much greater height. It is well known how limited our knowledge of the upper atmosphere is, nor has any means for attempting to reach this unexplored region been made up to the present time.

Investigations of such a nature as to determine the density, chemical constitution and temperature of the upper atmosphere as well as the height to which it extends, have naturally never been investigated. Whether or not there is a gas surrounding this earth called *Geocoronium* has often been hypothetically suggested, and in fact this gas has shown a spectrum which is a single Aurora line. It is reported to be 4/10 as heavy as hydrogen. Its investigation would be only one of the many considered important to astronomy, physics, and meteorology. Accordingly, Dr. Goddard has carefully studied the problem and has divided his treatment of the subject into three parts: (1) the theory, (2) experiment, (3) calculations, based upon the theory and the experimental results.

At first the question of

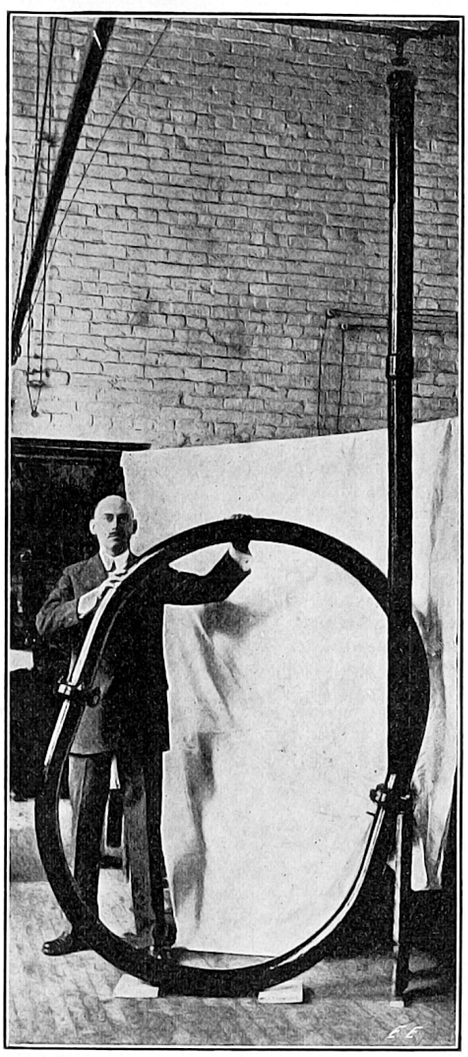


what method was to be employed, was taken into consideration, and decision finally crystallized in the form of a rocket. Inasmuch as a maximum amount of energy necessarily had to be obtained from a minimum bulk of matter, much thought was given as to what substance would liberate such a large amount of energy, at the same time being sufficiently controllable, so that the rocket's explosions would not shatter the apparatus completely.



The Actual Rocket Used By Prof. Goddard in His Laboratory Tests.

An ordinary rocket, however, rises to but a very limited altitude; the powder which furnishes the energy forms only a fraction of the total mass of the rocket and only a portion of this energy is converted into real kinetic energy. This kinetic and potential energy is necessary in order to supply the force to raise the rocket. The ordinary rocket and the Coston rocket is as inefficient as a poor heat engine, and Dr. Goddard proves this by various experiments. It has been found that powder in the ordinary rocket consists of ¼ or 1/5 of the total mass, and its efficiency being only about 2 per cent, the average velocity of the gases expelled was about 1,000 feet per second. Even the Coston ship rocket which is used for signaling on board ships, and which has a range of at least ¼ mile, was found to be very inefficient. Experiments with the rocket invented by Dr. Goddard have shown that the efficiency has been increased to 64 per cent by changing the powder used on other rockets to dense smokeless powder. This is placed in a strong steel chamber provided with nozzles separably fitted, these nozzles having smooth tapering sides. The highest average velocity thus obtained by simply changing the mechanism and the charge was 8,000 feet per second.



Prof. Goddard and His "Vacuum" Pipe, by Which Tests Simulating Those in the Upper Atmosphere Were Made With His New Rocket.

The idea was to have most of the mass propellant, that is to say the efficiency of the rocket would be greatly increased if the contents would be about fifteen times the weight of the rocket and consist of propelling material. It stands to reason and it is quite easy to see that a mass of propelling material will naturally permit the rocket attaining greater speed and higher altitudes, and yet no attempt has been made to improve the ordinary rocket used for signaling purposes and fireworks exhibitions.

Another principle has been incorporated in the Goddard idea whereby a secondary rocket would be fired from the first rocket after it had reached a certain altitude, so that the weight in both would consist largely of propellant matter, and when the smaller charge of powder was left, the larger mass (dead weight of chamber holding previous charges) would drop off as dead weight.

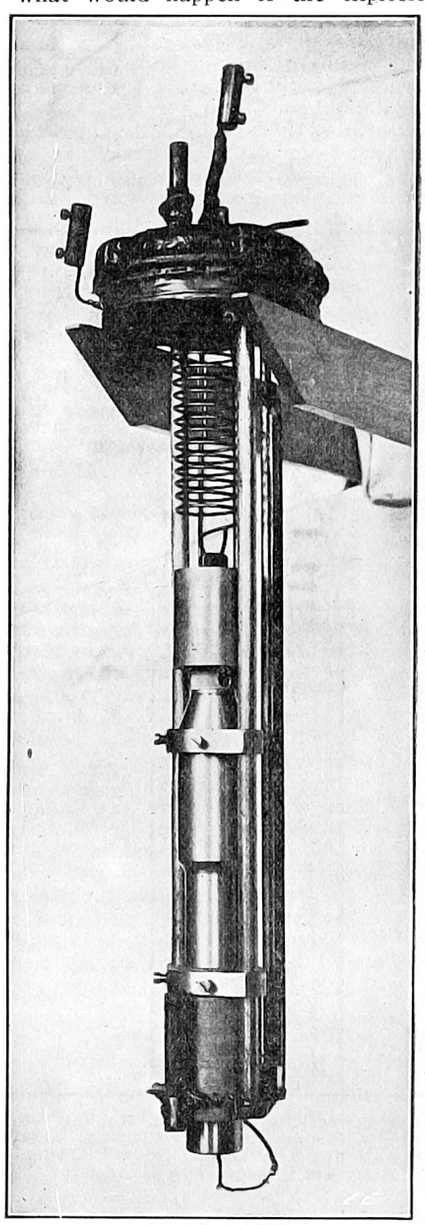
EXPERIMENTS.

Experiments were conducted along these lines of reasoning and the results are absolutely and thoroly accurate. Dr. Goddard has gone into the subject more deeply than an experimenter would. He has clearly demonstrated with photographs and data the possibility and plausibility of his ideas.

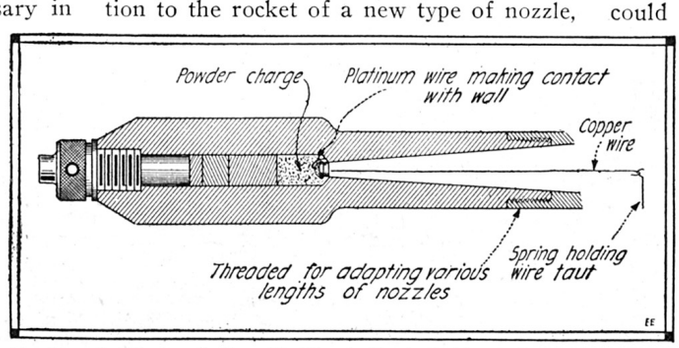
In order to obtain the velocity required, it was necessary to radically improve the form of rocket. Both the Coston ship rocket and the common type rocket used by boys on the Fourth of July are impractical and measurements obtained with a ballistic pendulum showed this to be so. In order to obtain the high velocity required therefore, several innovations were made. First —the employment of a stronger powder; dense smokeless powder was used, as it permitted of a much higher heat value than the ordinary black powder usually employed in the common rockets.

It was next desired to obtain very high pressures and a steel chamber was used for this purpose. Added to this was an addition to the rocket of a new type of nozzle, so that the work of the expansion of the gases would be available.

A small steel chamber was finally evolved. During the process of this work a model was constructed which could be readily reloaded and fired by electricity; readings on a ballistic pendulum and by direct lift showed an ejection velocity up to nearly 8,000 feet per second in the air for the new rocket. Now, the great question arose as to what would happen if the explosions could be continued without interruption until the rocket reached the higher altitudes, where obviously, there is no air. *Would the force of the charge have sufficient kick-back against this highly rarefied air to cause the projectile to continue in its course?* Accordingly a series of experiments were started and the results were even greater than those obtained in air, that is to say, the rocket was mounted in a vertical position, so that expelled gases were shot downward and the chamber moved upward by *reaction.*



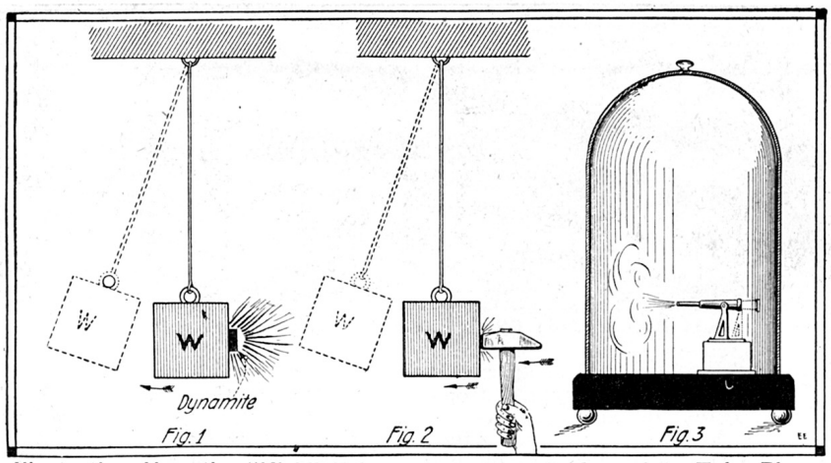
The Goddard Design of Aerial Rocket Mounted in Recording and Firing Head, Which Could Be Attached to Vacuum Chamber Shown at Left.



Sectional View of the Goddard Rocket Used in Laboratory Tests.

The rocket was mounted in a system which permitted it to be

suspended from a steel spring. A smoked glass plate alongside with an indicator showed exactly to what extent the rocket was propelled upward. The entire system was now mounted in a long tube-like chamber from which the air was exhausted. In the bottom of this chamber some very fine wire screening was coiled around in a spiral form, lying upon criss-cross screening, so as to scatter the force of the explosion and prevent any rebounding if possible. In this way, *only the actual kick-back effect produced* upon the rocket by the discharge, would be recorded. If this were not done, it is obvious that the gases striking the bottom of the tube, would be reflected and cause the rocket to move upward perhaps sufficiently to add quite something to the record obtained. In addition an *impulsemeter* was placed in the chamber to record any rebound. This was simply a thin pencil of lead with a flattened end mounted in a glass tube and suspended by a spring in the top of the chamber, so that if any gas was *reflected*, it would record on the impulsemeter. The readings on the meter were so minute that for ordinary discussion they would not even need to be taken into consideration. Thus the coiled mesh screening acted as a wonderful damper to prevent the mass of gas from being reflected and shot backward.



Illustrating How the "Kick" Effect or Reaction Is Caused to Take Place, Even in a Vacuum. A Gun Fired in a Vacuum "Kicks," the Same As in Air.

Notwithstanding the fact that these results would tend to impress even the credulous mind and convince them of the possibility and probability of the scheme, Dr. Goddard devised still another scheme, what he terms a *friction brake*. This consists of a large hollow wheel of iron with a pipe leading to its inner surface so that when an explosion occurs, it will cause the gases to come down on the inner side of this coiled pipe and the force of the explosion makes the gases travel to the outer surface of the oval tube, in this way dispersing their effect by the centrifugal force formed and preventing any reaction on their part by reflection.

In both the above experiments, the air was completely exhausted from the chambers in which the rockets were being tested by means of a stopcock. The circular testing tube shown in the accompanying photograph, weighed about 200 pounds and was 10 feet high. It consisted of a straight pipe, carefully fitted and welded to two sections of U-shaped pipe. In this way, the gases which were shot downward from the rocket in the straight portion, entered the circular part and passed around, due, as has been said, to the velocity and the centrifugal force, not returning up the pipe again, until of course, the energy was greatly reduced and affecting any record which the rocket itself might be making. Here as in the previous experiment, method of detecting gaseous rebound was employed. *It was found that the rocket had a greater velocity in a vacuum than when the same experiment was tried in air,* using the same chamber, same mass of powder and the same nozzle. The medium and short nozzles gave better results in vacuo than in air, but very little difference was noted when a long nozzle was employed, provided Du Pont powder was used. With other powders different figures were obtained.

In the cylindrical testing tube, which was used, an item of interest was noted in that when the explosion occurred the sound of the report resembled a sharp blow of a hammer on the cap of the pipe. With the results from this apparatus, it was seen that a body of this nature could travel through a vacuum, and make very good speed as the results of Dr. Goddard's experiments clearly show a possibility of obtaining a speed of 7,680 feet per second.

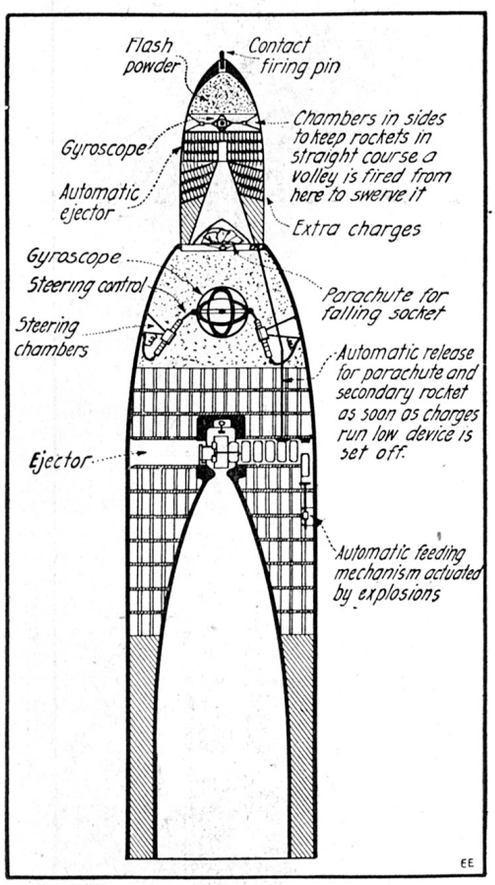
The fact that the velocities are higher in vacuo—as much as 22 per cent—than in air may be due to conditions of ignition quite different from those in air; and also due to the fact that there is no air to interfere with the stream lines of the gas. Photographs taken clearly show that the gas is really a jet having an extremely high velocity and is not merely a reaction against the air. This velocity depends a great deal upon the manner of loading, ignition and forms of nozzle; hence, in practice, care is taken to test out all forms of rockets.

A very peculiar feature of these experiments, demonstrate that an efficiency of fully 64 per cent can be obtained from this interesting engine, if we consider it as such. This is a good deal higher than any gasoline engine or internal combustion machine, the efficiency of which is about 45 per cent, and the best steam engine offers an efficiency of slightly over 21 per cent. It is doubtful whether any engine or turbine could compete with this type if it is considered as such. The highest velocity obtained exceeded 1½ miles per second.

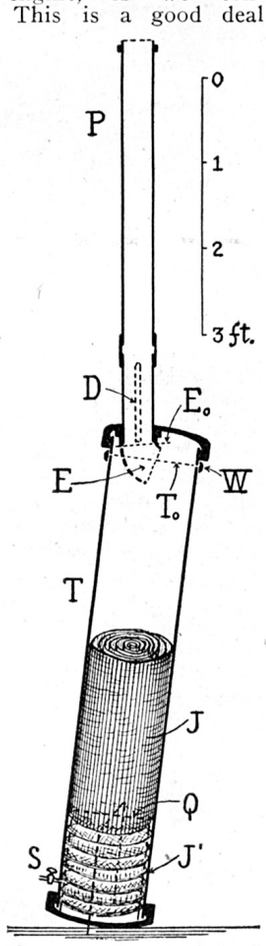
Experiments are now going on, which attempt to decrease the weight of the rocket itself, using a method of reinserting charges which are exploded periodically by machine gun like action. It is likewise the purpose of the inventor to have the mass of propellant material very large, so large in fact that the weight of the rocket itself and the accompanying mechanism will be a comparatively negligible quantity.

By applying these findings to further experiments for obtaining altitudes greater than the earth's atmosphere, some method must be arranged to bring any recording instruments safely to the ground again after the rocket has reached the desired altitude. For this purpose a small parachute is employed, as it can fall with remarkable speed in and thru the thinner strata of air, but when it reaches the denser areas it falls much slower and finally comes to a resting position without a thud. Hence practically instantaneous reports could be obtained as

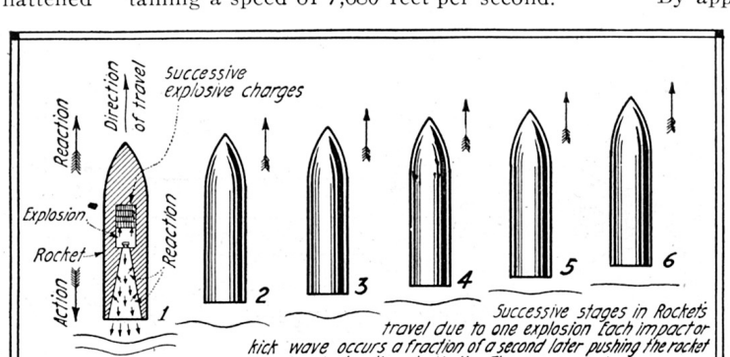
(*Continued on page* 1048)



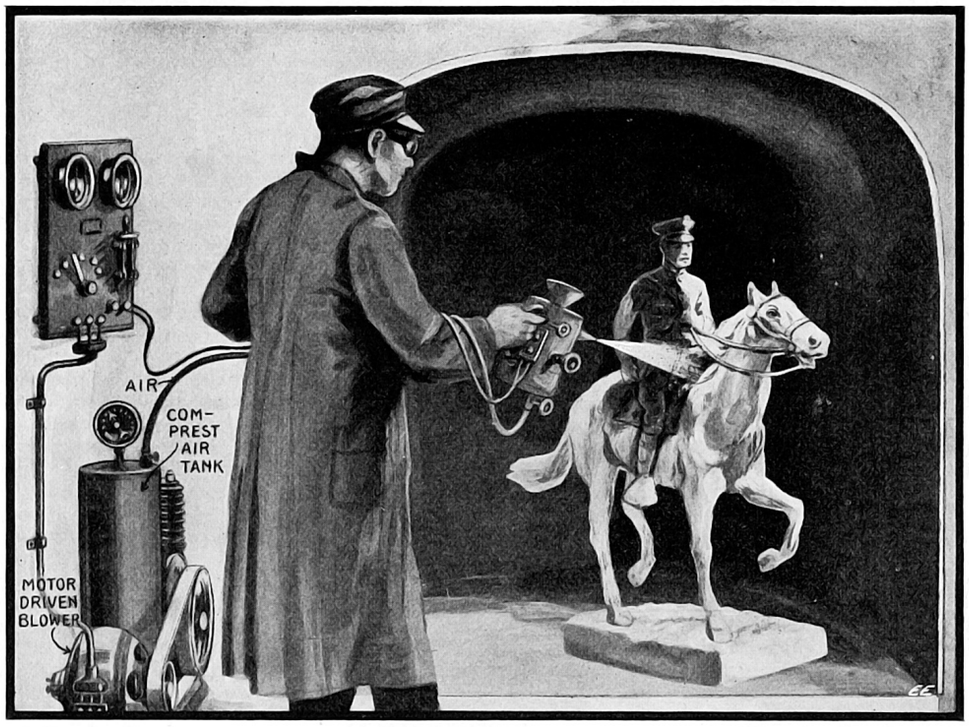
One Proposal for a "Moon Rocket"—Successive Charges Are Fired by a Machine Gun Action. The Lower Rocket Drops Off After Its Charges Are Exhausted.

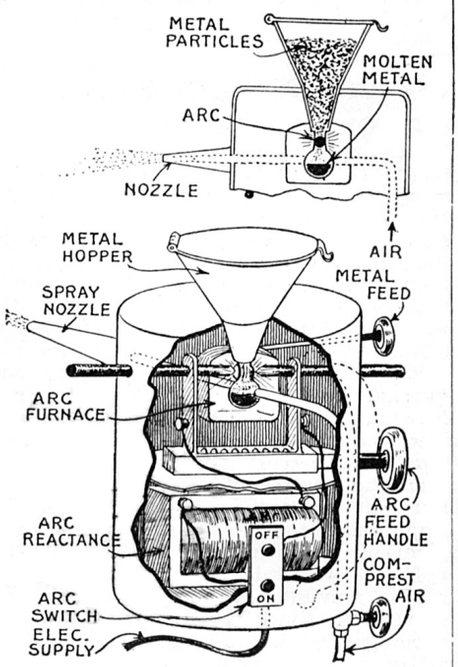


One Form of Steel Tank Into Which the Rocket Was Fired to Simulate High Altitude Conditions.



An Explosive Force Wave Will Push Any Obstacle, As a Rocket, in the Direction of the Expanding Waves, Even in a Vacuum.





The Wonderful New Comprest Air System of Plating Any Object with Metal to Any Desired Thickness. The Metal to be Plated on to the Object Is Placed in the Hopper of the Electric Arc Heater, Whence It Descends Slowly Into the Arc, Where It Is Instantly Melted and Then Blown by Comprest Air Thru a Suitable Nozzle Onto the Object to be Plated.

Plating By Comprest Air

A well-informed correspondent, Samuel Crowther, of *The New York Tribune,* lately returned from Germany, observed a method of plating metals, in which comprest air was employed. This machine for plating, the correspondent declares, is very highly regarded by the Germans. The surface to be plated is cleaned with chemicals and then a thin sheet of the plating metal is blown on with a device resembling a hand torch. The torch contains a small electric furnace which reduces the plating metal to a liquid and thru the connection with a tank of comprest air the molten metal is sprayed onto the surface. See accompanying sketch.

By this method, gun metal, brass and copper were put on iron or steel for such parts of machines as required it, the coated metal parts being used instead of solid gun metal, brass and copper. This saved large quantities of these three products when they were exceedingly scarce in Germany.

This particular comprest air and electric furnace plating scheme is portable and declared to be most convenient in usage. It is expected by the Germans to have a permanent and wide use in the coating of ships' bottoms, tanks and other large structures where the plates cannot be plated before erection. In fact, Mr. Crowther reports, it constitutes a new variety of metal painting arrangement.

The well-known Schoop process is said to be about eight years old and is capable of depositing lead, tin, zinc, aluminum, copper, nickel and their alloys on any coherent object, whether metallic or not. The thickness of the coating is under instant control and the application can be limited to any portion of the object.

The difference between the original Schoop method and that described by Mr. Crowther is that the former involved the use of a "pistol," air at 40 lbs. pressure, a tank of hydrogen and another tank containing some reducing gas, usually oxygen, acetylene or blau-gas, the metal to be applied being liquefied in flame; whereas in the latter a small electric furnace is utilized to make the metal molten before it is projected by the air pressure.

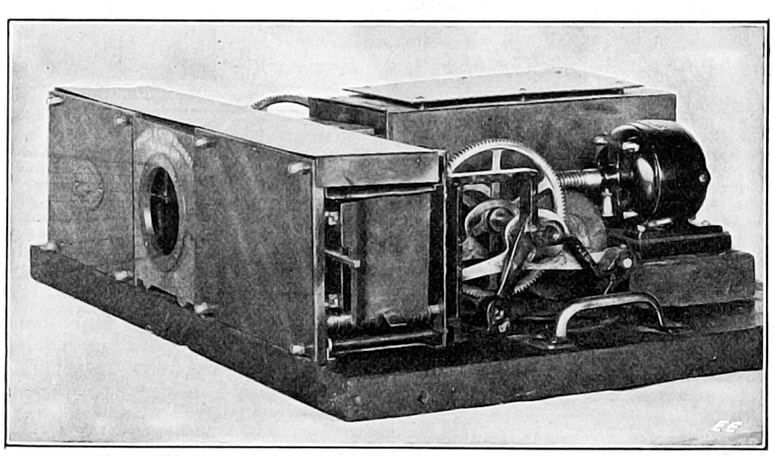
The Schoop process has been used in the United States to some extent, but is still susceptible of considerable development. Here its use is said to have been wholly for its convenience in ordinary practise and not as an economical expedient.

New Automatic Stereopticon

The Owen Automatic Stereopticon demonstrates a new use of electricity, and is a simple device that can be carried in a suitcase, costs little to operate, has nothing to wear out or replace, and will last practically a lifetime.

Its essential parts are a 1,000 candlepower, nitrogen tungsten projection lamp, condensing and objective lenses, a screen upon which the pictures are to be projected, the necessary slides, and a small electric motor to be attached to an electric light socket, and which operates by either direct or alternating current.

The usual size projects forty-six slides upon the screen, allowing each to remain in position twelve seconds, when it is automatically replaced by the next. Machines which project one hundred, two hundred or more slides may be built to order.



This New Automatic Stereopticon Has a 1,000 C. P. Tungsten Lamp, and 50 to 100 Slides or More, May Be Changed Successively and Automatically.

The picture may be shown either large or small by merely varying the distance of the objective lens from the screen. The projection is in the form of a cone with the small end at the lens, and the large end on the screen, and the farther the screen from the machine, the larger the picture.

This automatic stereopticon is invaluable for store and window advertising. — *Photo courtesy General Electric Co.*

Suspending Gravitation

By H. GERNSBACK

COMING INVENTIONS No. 4

FOR millions of years the human race has been reared on a planet upon which gravitational effects may be termed as being fairly high. All the various effects produced by the mass of the earth, not only on every human being, but upon every object as well, are so ingrained into us, and we have grown so accustomed to them, that it appears to us the most natural thing in the world when a stone drops or an apple falls from the tree.

We seldom try to fathom why such gravitational effects do occur, and until Newton first propounded his immortal work on gravitation, even deep thinkers did not clearly understand why a stone released from the hand should strike the earth with a thud. Even today few people realize what gravitational effects are. They will give you an off-hand answer, saying "Oh, yes! A stone falls downward because the earth's gravitation attracts it," and leave it go at that. But how many have ever given a thought to the idea what would happen to all of us if gravitation suddenly ceased?

Gravitation is not the same on all planets of the heavenly bodies. We have described in previous articles in this magazine the effects produced upon heavenly bodies smaller than the earth, where consequently the gravitation is reduced as well. For instance, a man who on earth weighs 150 pounds weighs only 25 pounds on the moon. On the little planetoid Eros, which has a diameter of only ten miles, the gravitational pull is practically nothing. Thus, the 150-pound man on this planet only weighs 2 ounces instead of 150 pounds. From this follows that *weight* is only a term conceived in our brain. It is only fairly stable on the earth. Remove the earth and you would be absolutely weightless, there being no gravity, except, of course, for the attraction of the sun or other heavenly bodies, if you came within their influence.

As Professor Einstein so aptly put it in a recent interview: "Take this house and remove the earth to an infinite distance. What happens? The house as well as the objects contained therein will weigh nothing out in space. Our bodies would float in the air providing air was retained in the house. We could just as well walk on the ceiling as along the sides and bounce from ceiling to the floor; it would be all the same. For in space there is no up or down, and the word 'weight' has no meaning."

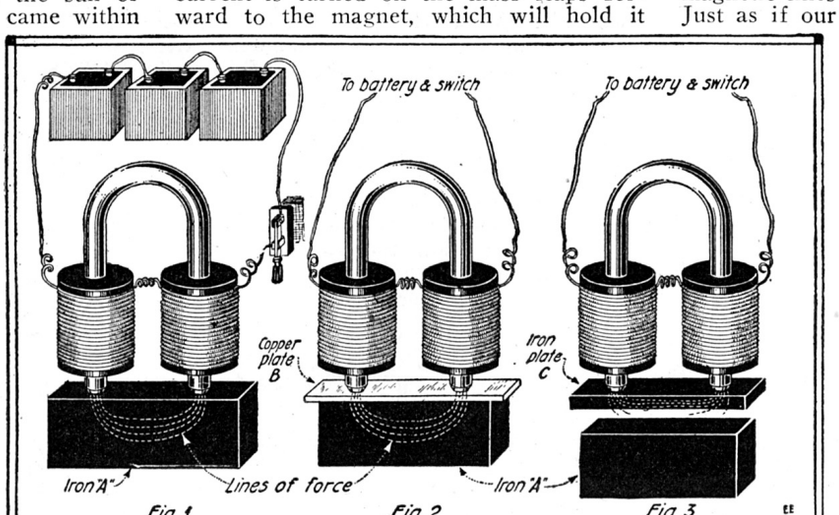
Recently a cable dispatch from Rome brought the announcement that Prof. Maiorana discovered that lead balls swimming on a pool of mercury lost a certain amount of weight. It was explained that the weight was lost due to a *screening effect* which the mercury produced on the lead ball. In other words, *mercury acts as a sort of insulator against the earth's gravitational waves.* For gravitation certainly is propagated the same as other forms of energy, i.e., in wave-form.

Prof. T. J. J. See, famous investigator of Mare Island, California, in an address before the California Academy of Sciences, announced recently that his researches on gravitation in 1917 and his latest researches on molecular forces confirmed Maiorana's claim that the screening of gravitation has been shown to exist. "In 1917," says Professor See, "I explained the fluctuation of the moon's main motion by the circular refraction of the sun's gravitation waves, as they are propagated thru the solid body of our earth at the time of lunar eclipses. I found also from dealings with capillary forces that quicksilver is indeed very resistant to the waves which produce molecular action, and this developed a new theory of the depression of the mercury in capillary tubes. This would tend to confirm Maiorana's claim that a basin of mercury beneath a suspended mass of lead may decrease the gravitation of the lead by a small amount. My researches on ether show conclusively that gravitation is due to waves in the ether, and certain very resistant bodies in the line of action may thus introduce a slight screening effect."

This reasoning opens up new avenues of thought of what may be accomplisht in the future when we have found *a perfect screen against gravitation.* Let us go back to our famous Newton experiment of the falling apple.

Suppose we find some means of interposing between the apple and the earth a screen which effectively cuts off *all* the gravitational effects *above* it. Then suppose we attempt to let the apple drop. *It will no longer drop because we have neutralized gravitation.* Of course, so far no insulator of gravitation exists, but that does not mean that one will not be found sooner or later. Let us now cite a very simple analogy.

Fig. 1 shows a powerful electro magnet. It will, let us say, attract one hundred pounds of iron. This is shown at A, which represents a mass of iron. The instant the current is turned on the mass leaps forward to the magnet, which will hold it attracted as long as the magnetism acts.



This Illustration Is Given to Show an Analogy Between the Attraction of Magnetism and the Attraction of Gravitation. In Fig. 1 the Iron A Is Attracted to the Magnet. In Fig. 2 Although We Interpose the Copper Plate B, the Iron A Is Still Attracted Because Magnetism Passes Through Copper the Same As Water Through a Sieve. But in Fig. 3 the Iron A Is No Longer Attracted Because the Iron Plate C Now "Insulates" the Iron A from the Electro-Magnet. The Electro-Magnet Now Is "Short-Circuited." If We can find a similar "insulator" for gravitation, then if you release a stone from your hand, it will no longer fall to the earth as long as the gravitation "insulator" is interposed between the hand and the stone.

Turn to Fig. 2. Here we repeat the same experiment, but between the magnet and the iron mass A we interpose a thick sheet of copper. The magnet still acts on the mass A just as if the copper piece B were not in existence. In other words, the magnetism passes right thru the copper mass just as your apple will be attracted by the earth, even should you interpose a sheet of copper between the apple and the earth. Gravitational effects will still flow thru the copper as if it were not there, exactly as is the case with our magnet.

If, in Fig. 2, we substitute various other bodies we find that, with one or possibly two exceptions, the effect will always be the same. If the copper sheet B is removed and instead of it we substitute a slab of marble or a plank of wood, or most any other substance, the effect will still be the same. The iron mass A will still be attracted by the magnet, the magnetism passing right thru the marble, thru the glass or thru the other substances, just as if they were not there. *All these substances act to magnetism just like a sieve acts to water.* It makes no difference if our sieve be made of copper, glass or any other substance, the water runs right thru it, as we well know. So with magnetism and the various substances.

Now turn to Fig. 3. If instead of our copper sheet, we now substitute a thick *iron or nickel* plate, C, our magnet will no longer attract the iron mass A. Why not? For the simple reason that iron and nickel are about the only magnetic substances we know of. In other words, our magnetic lines, instead of attracting the mass A, now attract the iron plate, and effectively short-circuit what we call the *lines of force* emanating from the magnet; for this reason no magnetism worth mentioning reaches the block A. As seen in Fig. 3, altho the current is on, the mass A is no longer attracted. What have we accomplisht in this experiment? Simply this:

We have effectively placed a *screen* between the magnet and the mass A. In other words, the iron plate C no longer acts like a sieve, because it does not let pass magnetic lines of force, *but absorbs them.* Just as if our sieve mentioned above was made of blotting paper. We know that blotting paper has many fine pores, and altho acting as a sieve in a way, we keep the water from rushing thru it because now the sieve, strictly speaking, does not act as a sieve any longer, i. e., it *absorbs* the water.

The same with gravitation. If we can find a means, and I predict that such a means will be found in less than one hundred years, to effectively screen gravitational effects, the most wonderful era will have dawned upon humanity.

We know today that gravitational effects are mainly electrical. We already described in our March 1918 issue (page 743) of the ELECTRICAL EXPERIMENTER, Professor Francis E. Nipher's historical experiment conducted at the St. Louis Academy of Science, in which he actually demonstrated that *electricity acting upon lead balls effectively reduces gravitation.* This certainly proves the correlation between electricity and gravitation, and at a not far distant date I predict that a way will be found to entirely nullify all gravitational effects by means of electricity.

Suppose someone perfects a gravitation screen, a metallic or other screen which is

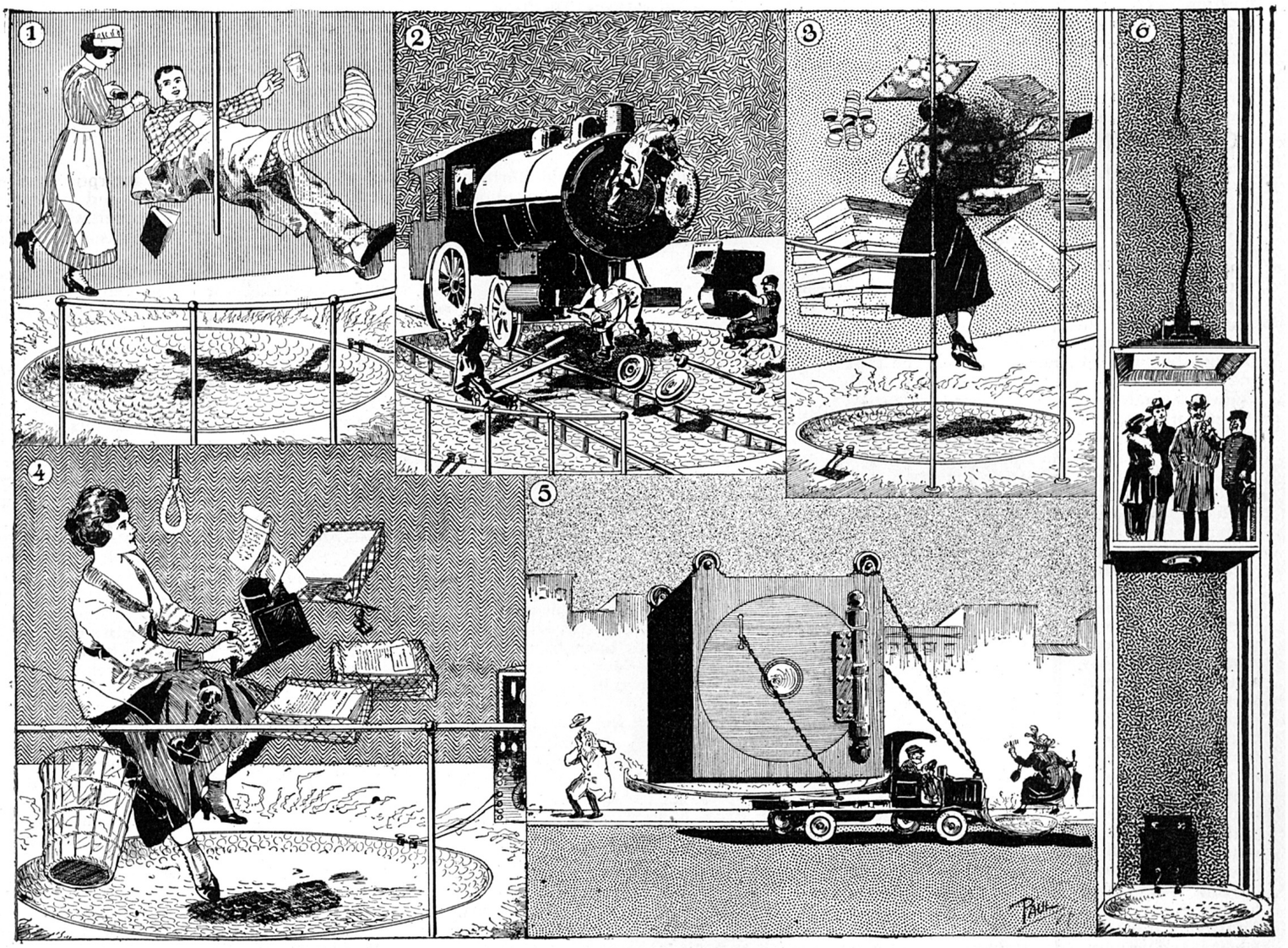


Fig. 5.—Several Applications Showing What Happens When We Have Discovered a Gravitation "Insulator." 1. Shows a Patient Who No Longer Requires a Bed for Resting; He Stays Suspended in the Air. 2. Shows a Locomotive Being Assembled Without the Necessity of Electric Cranes and Winches. The Locomotive and Parts Weigh Nothing, Hence Will Be Assembled in a Fraction of the Time Required to Do This Now. 3. Factory Scene Showing Operator Assembling Goods Practically Without Effort. Note That Her Work Is Spread Over Different Planes. 4. This Is What Your Future Office Will Look Like. The Disorder Is Only Apparent. The Typist Will Keep Her Basket and Papers, Etc., In Most Accessible Positions. There Will Be No Fatigue, and Work Will Be Like Play. 5. How a Very Large Safe Can Be Moved By a Very Small Truck. The Safe Being Weightless, It Can Be Moved Without Effort. 6. When the Elevator Cable Breaks, No Harm Is Done, for the Elevator and Occupants Weighing Nothing, Cannot Drop Down the Shaft, Due to the Suspended Gravitation.

laid flat upon the earth. It is then charged by means of a certain form of electricity as depicted in Fig. 4. The screen here shown is made of round circular discs invented by Nikola Tesla, because round discs, when used in connection with tremendous high frequency currents, do not cause such great loss by radiation in the atmosphere as if a single sheet or net were used. The screen suggested would be in the form of a shallow sauce-pan as shown.

As soon as energized in the correct manner all *gravitation above the screen will be shut off*. In other words, any object placed above the screen no matter how high above it will become weightless. It will have mass but no weight. Suppose two lead balls were suspended above the screen. These would of course not drop down to the ground now. They would stay freely suspended, but a curious thing would happen. These two balls if placed near enough together would gradually draw together and finally collide, because each sphere according to Newton's law of gravitation would now be a "planet" by itself, and one sphere would act upon the other. The effect however, would be extremely slight; all *in proportion to the size of the balls.* This experiment is only mentioned because it should be borne in mind that in the other examples which follow, there will be *mutual gravitational attraction* between the various bodies floating in the air such as shown in Fig. 4.

For instance, there will be a certain amount of gravitational attraction between the man and the little foot-stool. This effect, however, is so negligible that at the distance shown in the illustration, there would not be enough gravitational attraction between the two bodies to attract each other sufficiently to make one object move to the other.

Let us now see what happens, when gravitation is suddenly suspended. Fig. 4 and our cover illustration shows this graphically. There being no weight whatsoever, the two persons shown can move their hands and bodies any way they wish without the slightest effort. They can assume any pose they desire and they will stay suspended, hanging as it were, fixt in space, unless they jerk themselves out of their position into another one. It will be seen that the little foot-stool hangs suspended in a curious

Fig. 4.—A Reproduction from Our Front Cover Drawing, Showing What Happens to You At Dinner When Gravitation Is Suspended. The Girl, By the Way, Is Not Blowing Bubbles, But Is Drinking a Grape-Fruit Highball, Which, of Course, Weighs Nothing. The Ball Formation Is Caused By Surface Tension, Which Causes Liquids to Form Into a Sphere. This Is the Same Principle That Makes Small Drops Perfectly Round.

position. The lady just gave it the very slightest kick, and it immediately collided with the gentleman's leg, only to bump back again towards the lady's feet; this would have kept up indefinitely, were it not for the resistance of the air, which after a few oscillations stopt the foot-stool in the position shown.

How did the lady and the gentleman as well as the different table utensils come to be in the position as shown in our illustration? Before the current was turned on they were seated at a table in the usual manner with the objects on the table. The current was then turned on, effectively making the two human beings as well as the table and the other objects weightless. Holding on to the table, both slightly pusht against the electrified screen and immediately both table and everything else went sailing a few feet into the air. If the push had been too hard they would have landed with their heads against the ceiling, so the push necessarily had to be *very* slight. An attendant then came along and pulled away the tables and the chairs with the resulting effect shown in the illustration. The objects could no longer fall, and therefore remained in the positions shown.

The gentleman now wanted to smoke and removed the matches and cigarettes "laying" beside him. After he had removed his hands from them, *the objects remained just where he left them.* They could not of course fall. The lady then profest a desire to have a grape-juice highball. Her companion took the glass containing grape-juice, turned it upside down, *but not a drop came out.* There was no gravitation, hence the liquid could not flow out of the glass. Then he simply *jerked* away the glass with a quick movement, and the grape juice came out of the glass *by reason of its inherent inertia.* Due to the *surface tension* present in all liquids, the grape juice immediately formed itself into a small sphere. Surface tension in liquids always tends to produce balls of any liquid, as you may easily convince yourself by spilling drops of water on a cloth, and particularly velvet. You will see that the drops form themselves into perfect spheres. But drop a glass full of water on the velvet and it will spread all over. Why? The gravitational effect of the earth interferes with the surface tension and is sufficient to prevent the water from forming itself into a *big* sphere. In other words, in dropping water, *only small spheres can be formed,* because on them the gravitational effect is small, and not sufficient to overcome the surface tension of the liquid. But where no gravitation exists as in our illustration, you can readily take a bucketful of water or any other amount and after jerking the pail away, the water will remain suspended in the form of a sphere.

After the gentleman in our illustration had shown the effect to his companion, he proceeded in the manufacture of the grape-juice high-ball in a novel manner. Instead of mixing the grape juice in the glass, he simply took the siphon which was handy and squirted the seltzer right into the sphere of grape juice while the lady stirred it thoroly by means of her straw. During this operation the sphere did not stay perfect, but wobbled a bit just like a soap bubble wobbles and contorts when we blow against it. The second she ceased stirring, the whole formed itself into a beautiful light purple sphere—the grape-juice high-ball was ready for consumption. She applied the straw to it and drank from it as shown in the illustration.

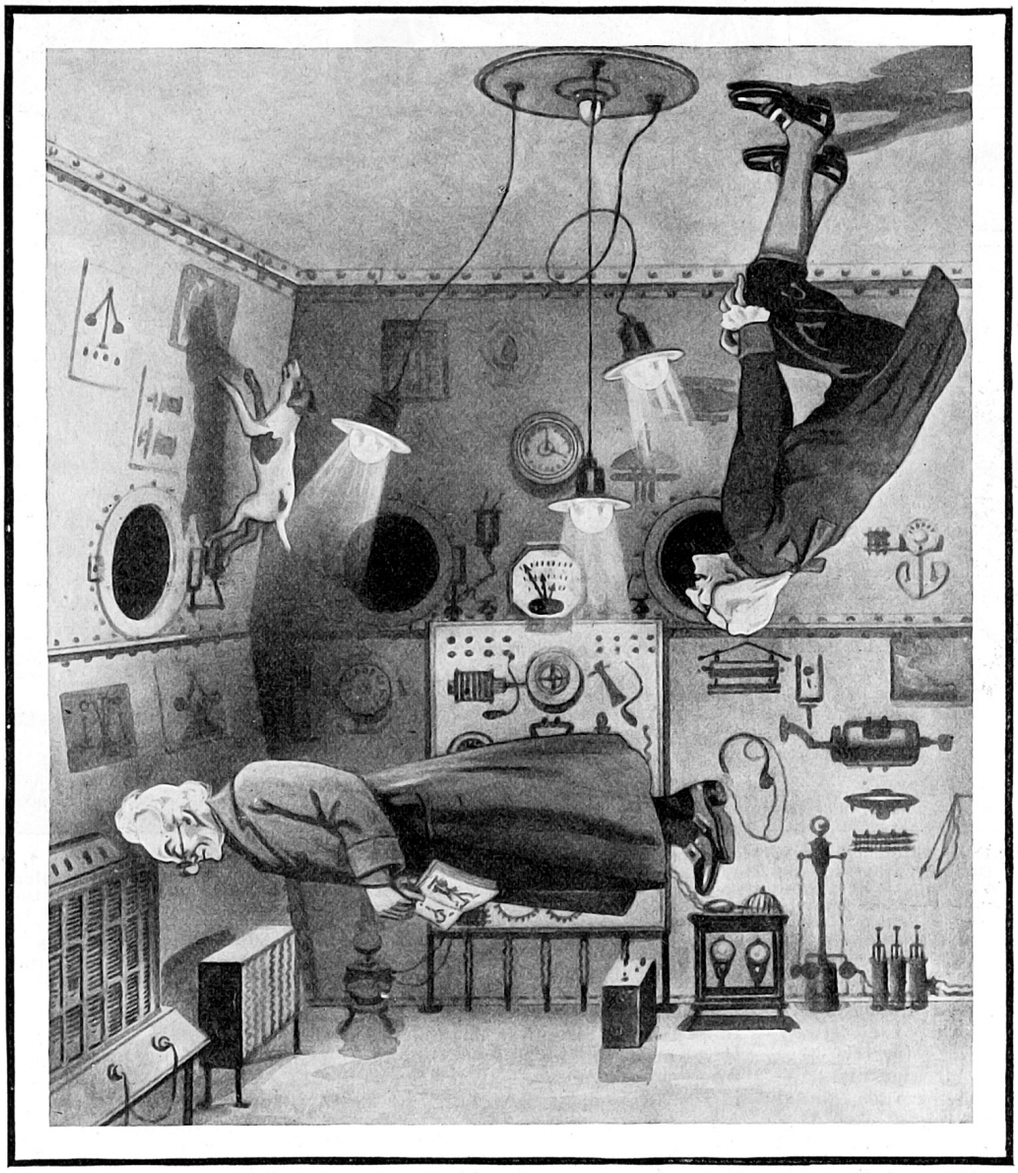
En passant we might mention that if the lady is fond of spaghetti, she will have no trouble whatsoever to eat it, for it will certainly not fall from her fork, and if it should slide because of its being slippery, it certainly will not fall on her dress. Neither need she fear that her egg would bespatter her, for it would not slide from her fork onto the dress.

A curious thing that these two people find immediately is that literally *they will tread on air.* Their bodies have no weight whatsoever, and therefore nothing will seem heavy to them and all movements will be accomplisht with the greatest ease. An arm left in a certain position, as for instance, the gentleman's arm in the illustration, will stay in the position shown. It will not fall to his body, for it has no weight. It will be a delightful sensation for our weary bodies if we succeed in suspending gravitation. Always remember that *most tiredness is produced mainly by the great weight of our bodies.* Take for instance our feet and legs which have to support the weight of our bodies. Our shoulders and backs become tired because they support our heavy heads and body. Hence, when we stretch out in our beds in the evening, we immediately reduce the gravitation because then our feet and backs do not have to support the total bodily weight any longer.

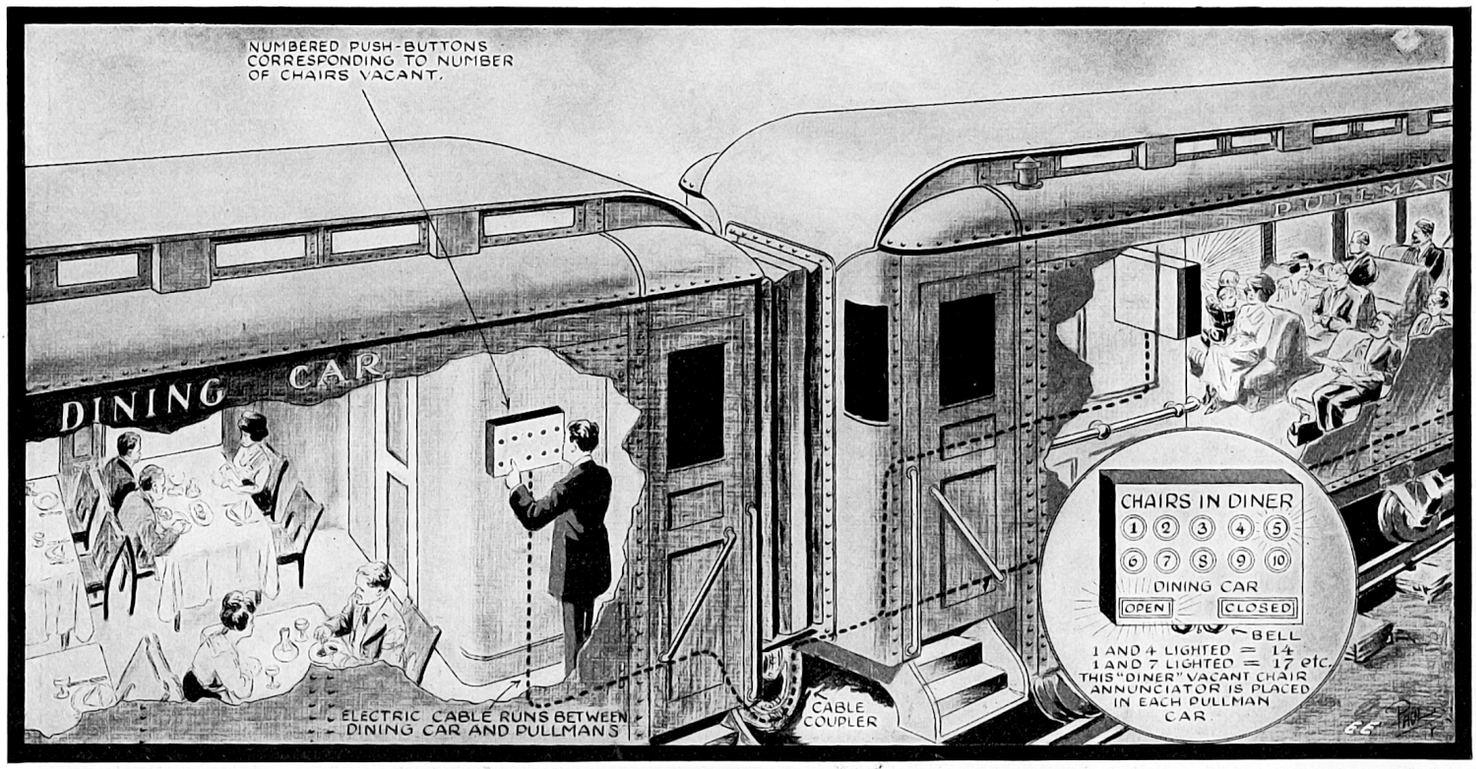
One important thing we must remember in this experiment. If the sun or the moon were overhead and if the room were open, all objects would immediately rise skyward, due to the attraction of the sun or moon if overhead. The two human beings shown in our illustration would then float a considerable distance upward until the wind blew them *beyond the limits of the screen,* when of course they would be dasht to earth and probably killed. This experiment if conducted will have to be made in a closed room, or at least one with a ceiling.

If we wish the objects not to bump against the ceiling, *if the sun or moon are overhead,* it would then be necessary to have an electrified screen *under* the ceiling as well, in order to cut off the gravitational effects from the sun or moon as the case may be. Then the objects would stay readily suspended in mid-air. The reader may wonder how the two people will get down again to *terra firma.* Very simple. The current is gradually reduced when the gravitation will make itself felt again and the bodies will settle down gracefully

(*Continued on page* 1050)



A Reproduction from Our June, 1915, Issue, Illustrating Mr. Gernsback's Story, "Baron Munchhausen's Scientific Adventures." The Scene Shows What Happens to the Occupants of an Interstellar Space Flyer. As Soon As the Machine Gets Out of the Gravitational Influence of the Earth and Moon All Objects Inside Become Weightless. The Ceiling or the Walls Are All Alike and You Can Walk on Either of Them. A Slight Jump and You Will Bump Your Head Against the Opposite Wall. You Can Get a Refreshing Sleep by Stretching Out in Mid-Air in Any Position You Desire. You Cannot Fall. A Recent Statement by Professor Einstein: "Take This House and Remove the Earth to An Infinite Distance. What Happens? The House As Well As All Objects Therein Will Weigh Nothing and Our Bodies Would Float in the Air. We Could Walk As Easily on the Ceiling As Along the Sides. In Space There Is No Up or Down and the Word 'Weight' Has No Meaning."



Yes, Yes! It Just Had to Happen Some Day! No Longer Will You Have to Walk Thru a Half Dozen Pullman Cars to the "Diner" and Find That You Have To Stand, With a Dozen Others, For Possibly Twenty Minutes Before Being Seated. This New Dining Car Annunciator, One of Which Is Located In Each Pullman, Indicates At All Times the Number of Dining Car Chairs That Are Vacant.

At Last! A Dining Car Annunciator

HAVE you ever traveled any appreciable distance on railroad trains, and been surprised at the unscientific manner in which the dining car service is handled? What we mean to say is—have you ever chanced to be one of a group of 15 to 20 hungry persons who have probably walked about 6 or 8 cars ahead, or to the rear, and found yourself compelled to stand for 20 minutes or more before you were seated? If you are a traveler, undoubtedly you have, and it was on a recent Western trip that the writer had the happy idea strike him to suggest the use of an electric annunciator for indicating in each Pullman car approximately the number of chairs empty at any time in the dining car, and also when this car is opened and closed for service.

The accompanying illustration shows the whole idea in actual operation. In view of the fact that railroad companies have seen fit to place electric berth annunciators in each Pullman car, with numbered indicators for each berth in the car, in order to inform the porter which berth the call comes from, it would seem a reasonable and useful innovation if they were to adopt this dining-car annunciator.

The other features of this electric annunciator system for indicating to the passengers in each Pullman car the approximate number of chairs vacant from time to time in the diner, are as follows:

There is one annunciator, fitted with electric call bell, placed in each Pullman, and all of the annunciators are controlled by the same wires from the master keyboard in the dining car. The dining car chief periodically pushes one of the numbered buttons on this keyboard, which causes an electric light to flash up behind the corresponding number on each of the annunciators. We will not enter here into a discussion as to how the total number of vacant chairs at any one period are to be apportioned to the passengers in the various cars, for there are several effective ways in which this could be handled.

The chief might, for instance, divide up the total number of vacant chairs among the total number of Pullmans, and push a button for each car which would cause the annunciator in each case to indicate the number of chairs vacant for that car.

It would seem, however, a generally satisfactory plan to have the chief select a mean average and take a chance that probably at one time a lesser number, and at another time a greater number, of pasengers would come to the "diner" from all of the cars, than the total number of chairs vacant at the moment. This would cause but little inconvenience in any case.

A detailed view of one of the Pullman car annunciators is shown herewith. In this proposed design, if the lights 1 and 4 are illuminated simultaneously, then the number of chairs vacant is 14. If the lights 1 and 7 are turned on simultaneously, then the number of vacant chairs would be 17, etc. Lower numbers than 10 are indicated by flashing up the respective number. Electric lights also flash up behind the signs "open" and "closed" in the respective cases, and this will save considerable inconvenience on the part of some travelers, who may, at the last minute, decide to visit the dining car, but who cannot be served owing to the nearness to closing time.

The electric cable for this annunciator service can be connected by a quick-acting coupler between the cars when the train is made up. The annunciator system can be operated by batteries, either independent or connected with the electric lighting supply of the cars.

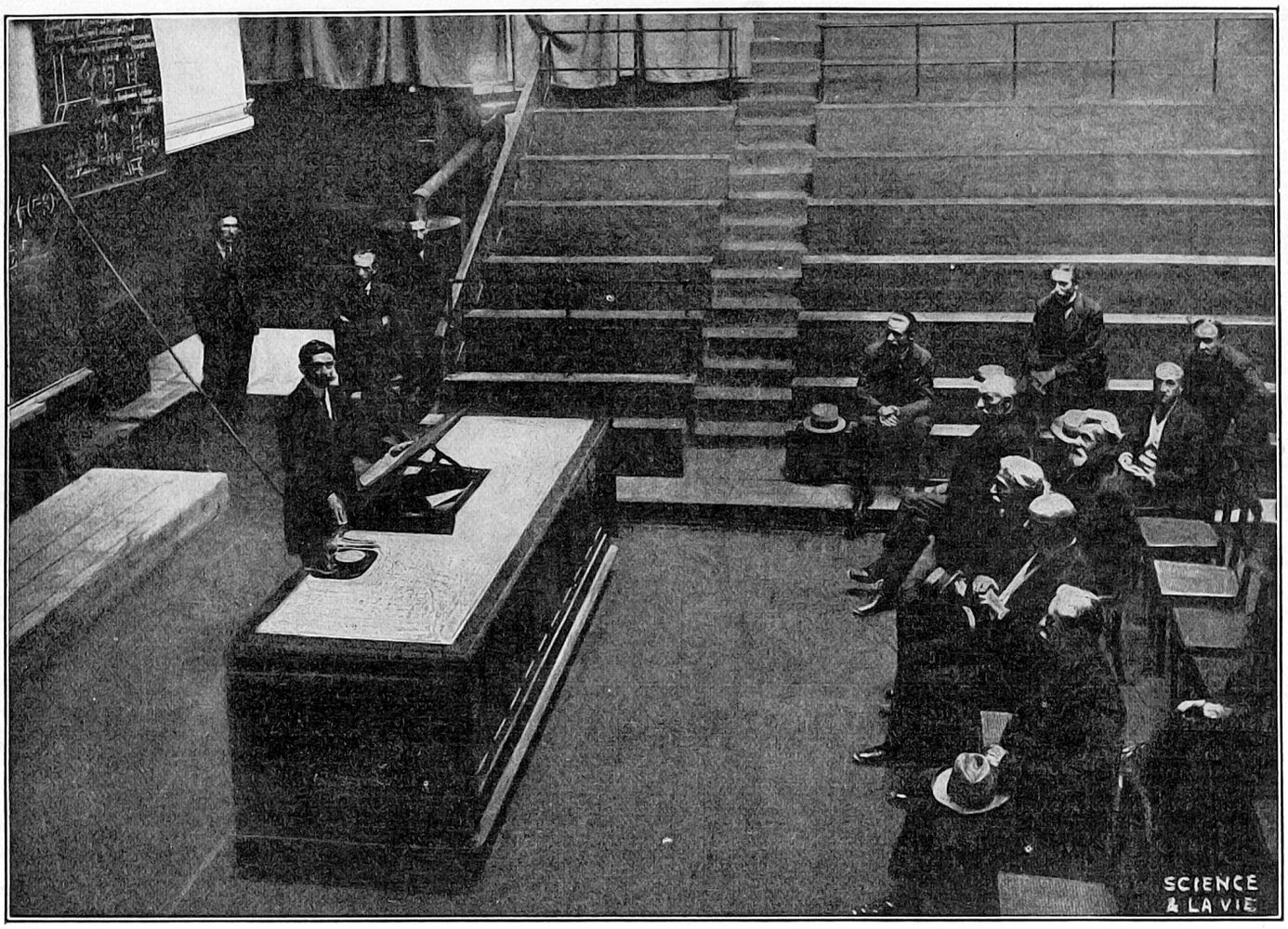
While we have not seen this idea suggested before, and believe it to be quite original and perhaps radical to many railroad men, still we have received several compliments already from people who have done considerable traveling on railroads, and their first exclamation is, "At last! Why didn't someone think of this before?"

100 Flying Hours for Liberty Motor

In the opinion of Colonel H. H. Arnold, recognized as one of the greatest authorities on aviation in the army, one great result of the recent transcontinental air race is the definite knowledge obtained on the probable life of a Liberty motor.

"We have never known before what the life would be of a Liberty motor," said Colonel Arnold. "We have never tested them to the utmost of their endurance before. Now we can say the life of a Liberty motor is about 100 flying hours. We have learned that while it is perhaps the best airship engine made it is not the super-engine some of its designers hoped for. Some of them were hopeful enough to say it never would wear out. The development of the new mica spark plug in the place of those formerly made with porcelain cannot be over-estimated.

"Another fact learned during the race for the first time is that all parts of the Liberty engine are not interchangeable when the parts are made by different factories. Some parts on the engines made by the Ford plant and by the Lincoln plant are not interchangeable, as was demonstrated at Presidio field when the changes were being tried. The assertion that any part of any Liberty engine could be interchanged with any similar part from any other engine, even tho made at a different plant, has been one of the most widely advertised features of the new engine."



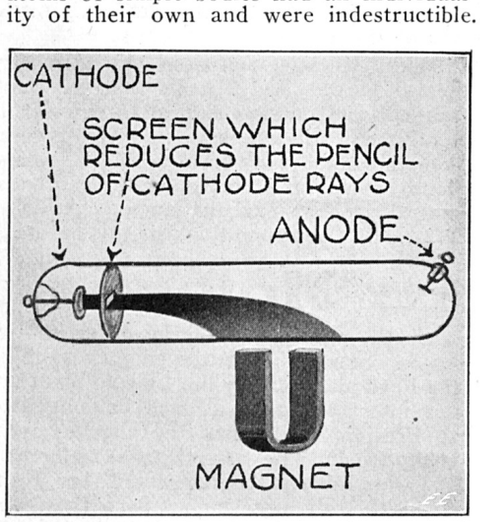
Professor Jean Becquerel of the National Museum of Natural History of France, Delivering a Lecture on Physics.

How Becquerel Discovered Radioactivity

By JEAN BECQUEREL

PROFESSEUR DE PHYSIQUE AU MUSÉE NATIONAL D'HISTOIRE NATURELLE DE FRANCE

TWENTY-FIVE years ago French scientists believed that matter could not emit energy where none had been furnished to it. They thought that the mass of a moving body in no way depended upon its speed; that the atoms of simple bodies had an individuality of their own and were indestructible.



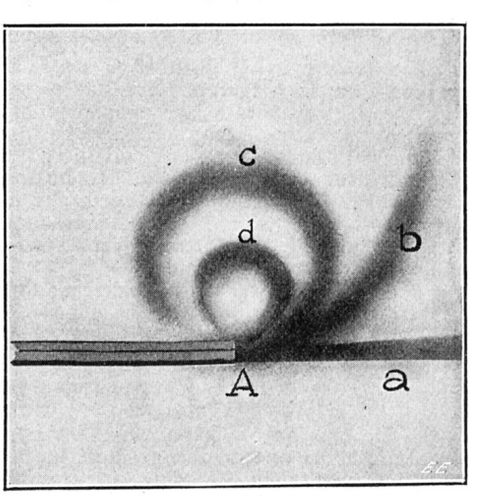
This Illustration Shows the Deflection of a Pencil of Cathode Rays by Means of a Magnet. It Clearly Demonstrates the Inter-Relation of Such Rays With Magnetism.

ONE of the greatest discoveries of all time — perhaps the greatest — was the discovery of "Radioactivity" by Henry Becquerel. It completely upset modern science and changed our entire long-reared structure of matter. Becquerel made the alchemist's dream come true literally, and there is little doubt that the World's great future inventions will have Radioactivity as their basework.

Radioactivity was no chance discovery. Rather it was a family achievement running thru four generations of the Becquerel family. Antoine Caesar Becquerel made extended studies of phosphoresence in 1839. His son Edmond Becquerel collaborated with his father, discovering the reason for phosphorescence, and in 1872 investigated particularly all Uranium salts. The grand-son, Henri Becquerel, who in turn took up his father's work finally discovered Radioactivity on March 1st, 1896. The great discoverer died in 1908.

The great-grand-son, son of Henri Becquerel, tells in this issue how the discovery was made. Of more than passing interest is the fact that all four Becquerels in turn held the Chair of Physics in the National Museum of Natural History of France from 1839, down to this very day.—EDITOR.

A wonderful discovery—that of Radioactivity, suddenly revolutionized science—overturned the best founded ideas and struck a mortal blow to the dogma of invariability of the chemical atom. This discovery showed that certain bodies, and probably all bodies, emitted rays, and that moreover this phenomenon is spontaneous; that the mass of a corpuscle, called Electron, depends upon its speed; that the atoms of



Spiral Movement of Cathode Rays in a Uniform Magnetic Field Perpendicular to the Direction of the Emission of the Beam.

A. Cathode Consisting of an Aluminum Wire Exactly in the Opening of a Small Glass Tube Giving a Very Fine Pencil of Rays.

a. Pencil of Cathode Rays Before the Magnetic Field Has Started. b, c, d. Three Different Circular Spirals of the Rays for Three Different Values of the Magnetic Field.

Written especially for the ELECTRICAL EXPERIMENTER.

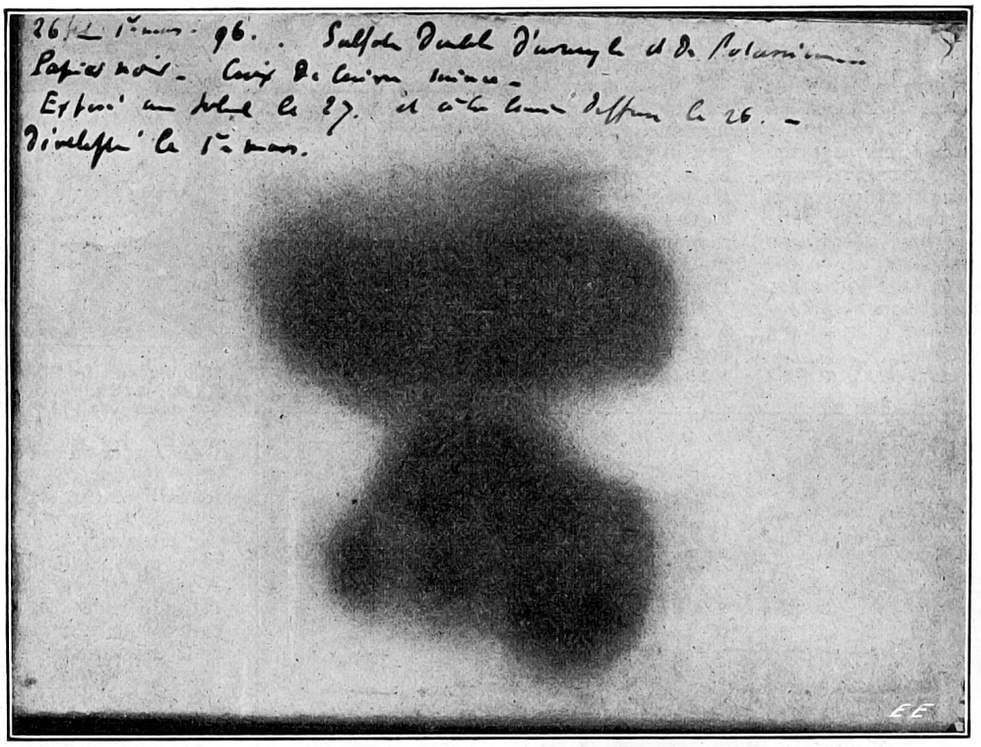
Copyright 1920 by E. P. Co., All Rights Reserved.

these radioactive elements are transformed in giving birth to other elements. Of these, some are ephemeral and others have a very long duration of life,—in short, matter itself is a formidable reservoir of energy.

The work leading up to this discovery is interesting, for the discovery was not at all due to mere luck; it was the logical consequence of a long chain of work and study accomplisht at the Physical Laboratories of the Museum of Natural History of France—since its foundation in 1839. The continuance of this work necessarily *had* to lead us to the study of the Radioactivity of Uranium—as we will show.

Here it is necessary that I indicate briefly the properties of phosphorescent substances. It is thus we term substances which can become luminous at an ordinary temperature, or at least a temperature very much inferior to that from which all bodies become incandescent due to the effects of heat. *Phosphorence is the result of a molecular excitation* which can be produced by visible light or by invisible luminous rays, either by rays obtained from discharges in rarefied gases, or by heat, or by mechanical action (rubbing, friction, fracture or crystals), and lastly by chemical action. Phosphorous, for instance, which becomes luminous while oxidizing.

As far back as can be remembered it was known that certain stones, diamonds in particular, had the property to glow for several instants in the dark after they had just been exposed to light. In 1602 a discovery called attention to the following phenomenon: an artisan of Bologna, Vincenzo Calciarolli, having found a very heavy stone (Sulfate of Baryta) heated it on coals and found that the oxidized matter (Sulfate of Baryta) remained luminous for some time after being exposed to day-light and then examined in the dark. From this time to 1893 several phophorescent substances were thus prepared and aroused the curiosity of scientists. I write the word "curiosity" purposely for no one had the faintest idea of the importance of these researches and nobody foresaw the capital rôle they were to play one day in the development of Science.



This Is the Famous Historic Photographic Plate Showing the First Evidence of Radioactivity Sought by Becquerel. The Writing on the Photographic Print Is Becquerel's and the Translation Is As Follows:
"March 1st '96. Double Sulfate of Uranyl of Potassium. Black Paper. Thin Copper Cross. Exposed to Sun the 27th, and to Diffused Light the 26th. Developed March 1st."
Note That in the Original the Shadow of the Copper Cross Shows on the Lower Spot. By Holding the Illustration About a Foot Away from the Eye, the Cross May Be Faintly Seen.

In 1839, Antoine Cæsar Becquerel, who until this time had devoted his time to the study of electrical phenomena, was led by his previous researches to study the action of electrical discharges on phosphorescence. He demonstrated that these phosphorescent discharges were only produced by the luminous rays of the spark and not by any electrical effect. His son, Edmond Becquerel, who had collaborated with him at this work, continued alone the study of phosphorescent bodies. He carried on unceasingly, thruout his whole life, the study of this subject; for he understood that these phenomena, which until that time were considered as mysterious, should certainly open a new road to investigation.

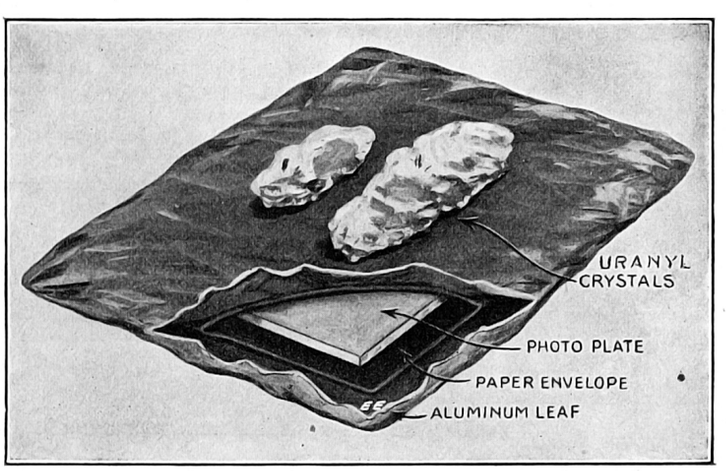
He described the means of preparing phosphorescent substances of various tints, sulfur of barium, Strontium, Calcium, etc., and *proved that these bodies owed their phosphorescence to traces of foreign matter;* with sulfur of Calcium for instance, a trace of Manganese gives red and yellow luminous effects; the presence of sodium salts and lithium gives green luminous effects; a small quantity of Bismuth gives forth a very luminous blue discharge. *Phosphorescence is due to the presence of some impurity.*

Edmond Becquerel studied the conditions under which phosphorescence can be excited, examined the light emitted by many substances and invented an apparatus called the *Phosphoroscope,* which reveals the phosphorescence in bodies of which the duration of luminosity is very short-lived. With this apparatus one can readily observe "flash" phosphorescence of a very short period (up to 1/40,000 of a second) in bodies after the light effect has long vanisht. The shorter the interval of time between the illumination and the observation, the larger the number of substances which produce the phenomenon of phosphorescence.

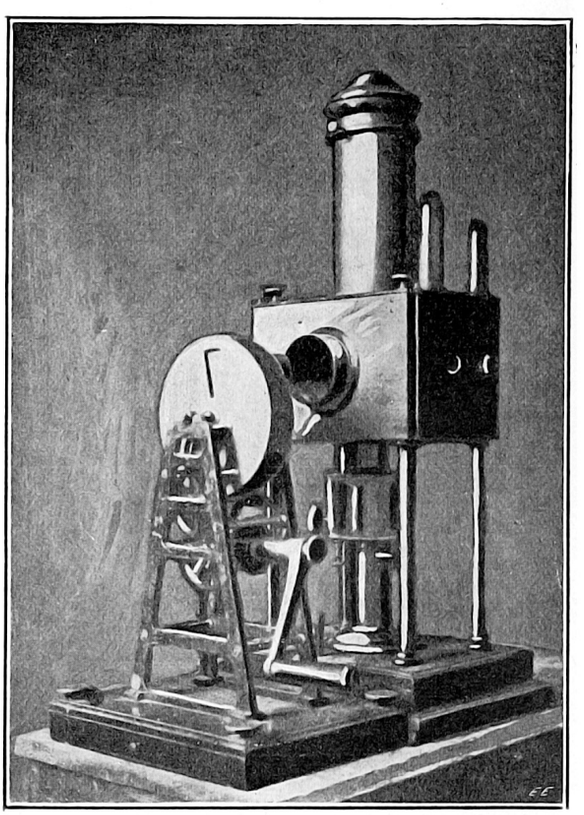
In 1872, Edmond Becquerel made a particular study of the phenomenon of phosphorescence.

Composites of Uranyl give forth beautiful green luminosity of very short duration (1/100 of a second) perceivable thru the phosphoroscope or by illuminating these bodies with violet light.

Everyone knows that white light is composed of different colors which are blended in the rainbow. The spectroscope permits the analysis of any sort of light and the separation of the different colors that light contains. If one analyzes the light emitted by a body one obtains the *emission spectrum* of that body. Furthermore, if one directs into a more or less transparent substance a beam of white rays and if one analyzes



How Becquerel Performed His Historic Experiment. A Photographic Plate Was Wrapped in Black Paper, This Again in Aluminum Foil. Uranyl Crystals Were Placed on Top. The Result Is Shown in Top Illustration.



The Famous Phosphoroscope Invented by Edmond Becquerel. With This Instrument "Flash" Phosphorescence of 1/40,000 of a Second Can Be Measured.

what remains of that light after its passage into the substance, one obtains with the Spectroscope, black lines or bands which correspond to the rays which have been stopt by the substance; this is called the *absorption Spectrum.*

Edmond Becquerel, discovered that the phosphorescence emission spectrum of composites of uranyl are composed of seven or eight—regularly distributed, and he also discovered that the absorption spectrum is formed by bands which in the violet and ultra-violet parts (the latter are invisible to human sight, but can be photographed) are an exact prolongation of the bands of phosphorescence.

Henri Becquerel continued his father's work and proved that these phosphorescence emission bands and those of absorption are distributed according to the simplest law which can regulate the distribution of Spectral bands; they form, in a way, a harmonic scale of colors.

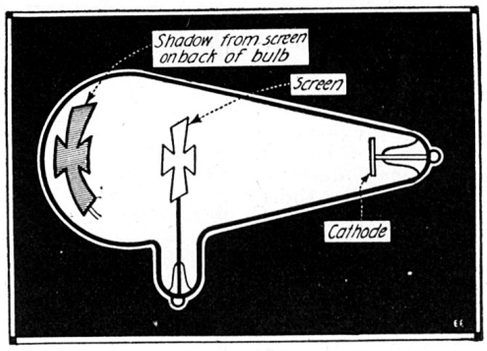
This result attracted his attention to Uranyl Salts. Another remarkable fact is the following:

Whereas the other substances owe their phosphorescence to the presence of impurities, as mentioned above, Uranyl Salts are *phosphorescent by themselves,* without the intervention of any foreign matter. In a word, Uranyl Salts occupy a place by themselves among phosphorescent substances.

I must now, before telling of the discovery of Radioactivity, recall other phenomena. Imagine a vacuum bulb; let us say in the form of a tube and containing a very rarefied gas as well as two electrodes; by connecting one of the electrodes to the positive pole and the other with the negative pole called the *cathode,* of a static machine or of a large induction coil, discharges are produced in the tube.

Plücker discovered in 1895 that the Cathode emits a certain radiation which has been called *cathodic-radiation;* these rays are invisible by themselves as they emit no light; but they are revealed by their property of illuminating phosphorescent bodies which they strike. It is thus that the glass of the vacuum tube becomes green wherever it is touched by these rays.

Cathode rays are deviated by a magnet, they tend to twist themselves about the lines of force of a magnetic field. They are also swerved from their course by an electric field: if past between two electrified plates (one positively and the other negatively electrified) a pencil of these rays describes a *parabolic* curve, just as does a falling body under the influence of gravity. Cathode rays are formed by a flow of corpuscles loaded with negative electricity. It is these cathode rays which give birth to the X-rays; the latter are generated every time cathode rays are suddenly stopt by a solid body. Nowadays we obtain X-rays by letting cathode rays fall on a tungsten electrode, called *anticathode.* But, during Röntgen's first experiments the anticathode was simply that part of the bulb which was opposite to the cathode.



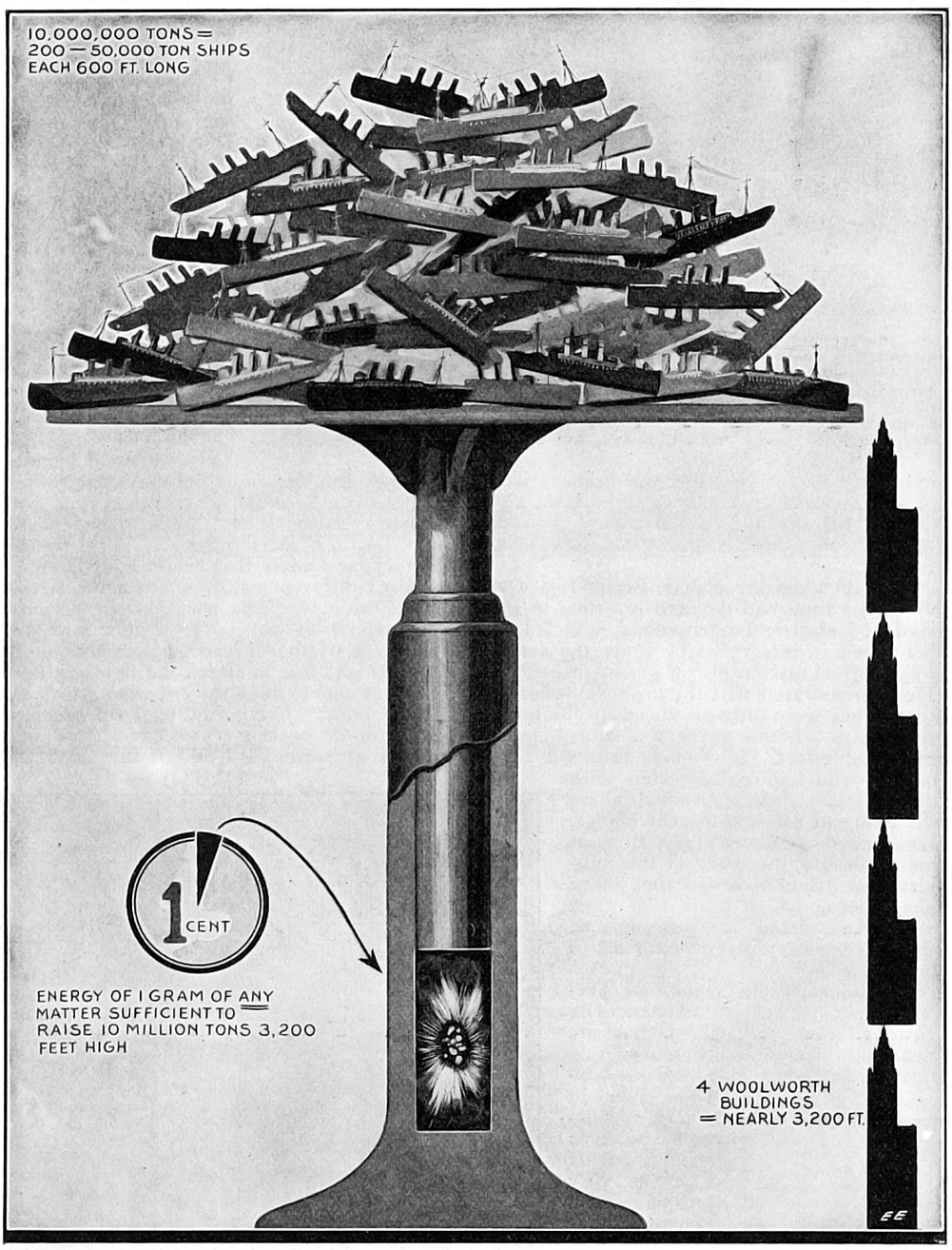
If a Screen Is Placed in the Path of Cathod Rays, a Shadow Will Be Thrown on the Opposite Wall As Shown in the Illustration.

The sensation caused in 1895 by Prof. Röntgen's discovery was considerable. On the day when this discovery was announced at the Academy of Science of Paris, Henri Becquerel asked Mr. Poincaré, who presented the note sent by Prof. Röntgen, "Just *where* in the bulb is the exact location from which the new rays are emitted?" He was told that it was the *phosphorescent* spot on the glass which received the cathodic flow. The phosphorescent part being the seat of emission, Henri Becquerel immediately conceived the idea to find out whether certain phosphorescent bodies could emit rays similar to the X-rays.

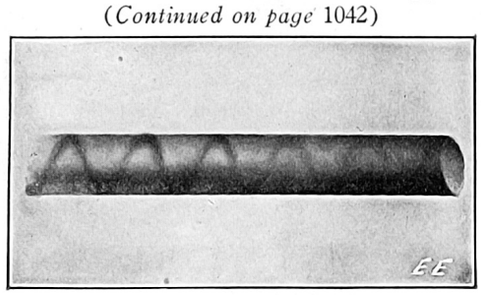
What then were the phosphorescent substances to be used in this experiment? Henri Becquerel did not hesitate; Uranyl Salts, which had been the object of so much research work in our laboratory and which distinguished themselves by their exceptional properties, were the natural and logical selection.

Believing that excitation by light was necessary to produce the desired radiation, Henri Becquerel placed crystals of double sulfate of Uranyl and potassium on an envelop of black paper, the latter covered with a thin leaf of aluminum and containing a photographic plate. He then exposed the closed package to the sunlight. The envelop of paper and aluminum prevented, of course, the light from acting on the photographic plate, but this could not be an obstacle to rays having like X-rays the property of penetrating opaque bodies. The plate was developed after being exposed for a few hours to the light and it showed very feeble spots which were *limited to the outlines of the crystals.* Naturally, Henri Becquerel wisht to repeat the experiment immediately, but as the sun was not shining the entire device was placed in a drawer to await better weather. The sun reappear-

(*Continued on page* 1042)



As Pointed Out in the Present Article by Prof. Becquerel, Computation Shows That if We Were the Master of Atomic Forces We Could Disintegrate 1 Gram of Any Matter and Liberate Sufficient Energy to Raise 10,000,000 Tons Four Times As High As the Woolworth Building.



Spiral Formation of Cathod Rays in a Uniform Magnetic Field Where the Lines of Force Are Oblique to the Direction of the Emission of the Rays.

The Golden Vapor

By E. H. JOHNSON

This is the story of a man possest of the highest type of scientific training, and who, because of disappointments that had come into his life, used his highly developed talents to plan and carry to a successful conclusion an enterprise mystifying to an extent unequalled in the annals of modern crime.

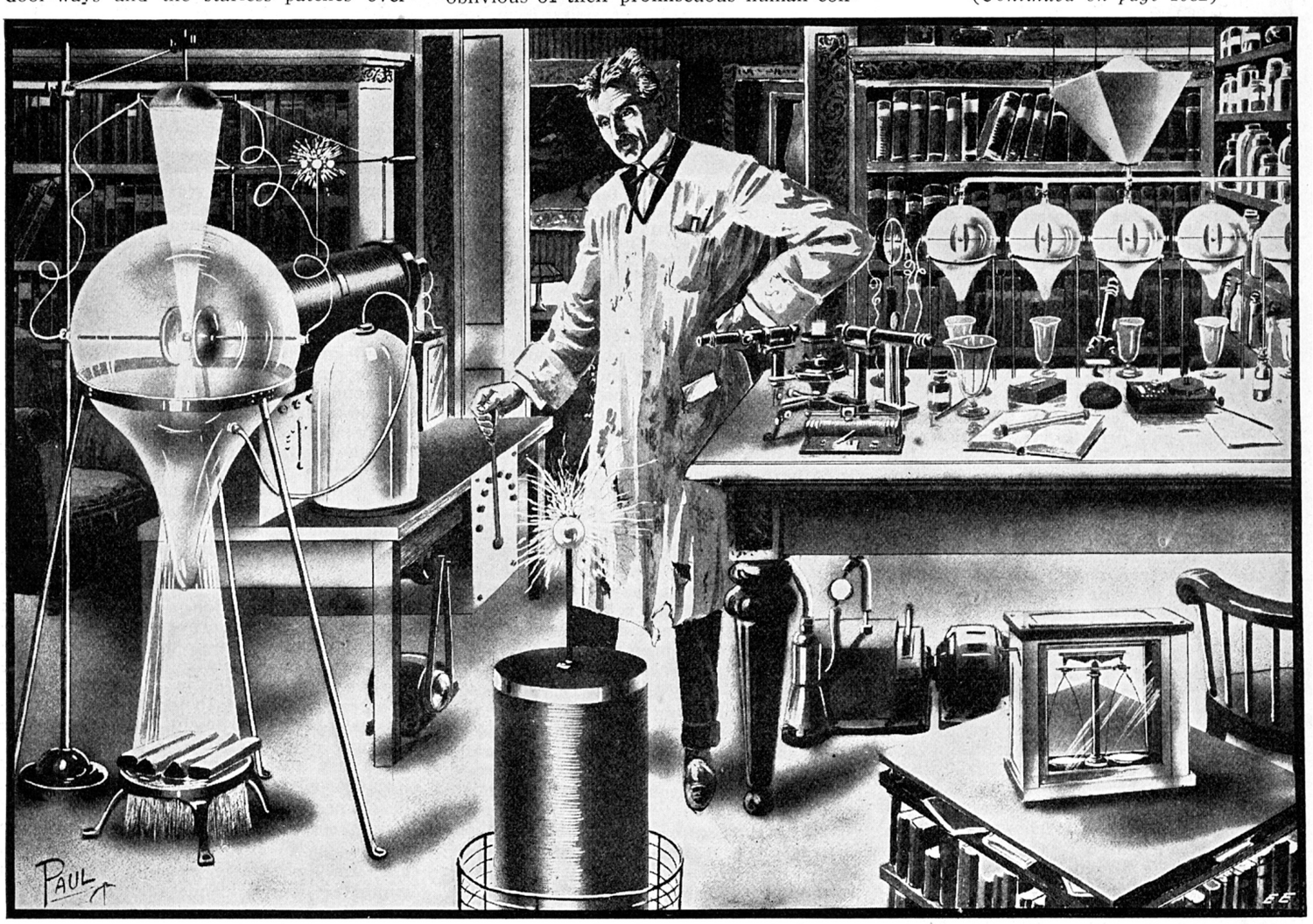
ON the fourth of December, 1919, the home-going crowds on the streets of San Francisco, like those in any other great city, were busy with their own thoughts. The louder noises of the day had ceased, and with the gradual peering forth of the myriad lights with which, like jewels, the fair queen was wont to adorn herself for an evening at home—a sense of calm security warmed the hearts of old and young alike. Comparative peace reigned on earth, and in the heavens above shone forth stars as yellow as the gold of California itself—and no more illusive. One alone of all the hurrying throng saw little of charm in that color. Though as thoroughly conscious as any other of his own safety, this conviction was of a defiant type which finds its assurance in the knowledge of successful craftiness, and fears little because little is loved. Occasionally he smiled grimly, almost cynically, as some ostensibly rich person swept by, or as he caught the faint odor of some rare perfume. These were but pretenses to a satisfaction that he had little faith in. They proclaimed a comfort which he thought at best to be but an illusion. Yet, human-like, he could not help wondering, for such a life was now well within his reach, but he only buttoned his coat a bit tighter about his meager form, glimpsing furtively, tho perhaps unknowingly at the darkened door-ways and the starless patches overhead. This strange appearing man was Dr. Rudolph Grieg, a doctor of philosophy, not of medicine and surgery.

Suddenly, familiar shouts filled the air as a half-dozen news-boys burst forth from a nearby building—a towering structure whose lower levels were teeming with chattering machines and dodging human attendants. The evening edition of a great paper was just emerging with its tales of a thousand horrors and frivolities which, regardless of variety, length or sense, were soon to beguile the fireside hours in a thousand homes. With the usual jargon, each boy tried to drown the advertising efforts of his fellows, so that however attentive a listener might be, he could only conclude that the day's events were not much different from those of other days. And each night, regardless of the nature of these announcements, each boy disposed of his wares before the "next car" with its strap-holders, swaying and reading, oblivious of their promiscuous human contacts in their absorption in greater or lesser human affairs—rushed away beyond the twinkling lights in the heart of the city.

Of all this crowd, Dr. Grieg alone seemed in no haste to depart. His keen ears had caught a word in the howling clamor of the newsboys and then with all his heightened sensibilities alert he had heard enough to cause him to do a thing which for him had become quite uncommon—to buy a paper. He had fairly snatched it from a boy who was running past, had cast a quarter in his direction and turned to a lighted window to scan the headlines with an evident excitement. The boy looked several times at the quarter he had received, started to speak once or twice, but then seeing that his customer seemed satisfied, raced on.

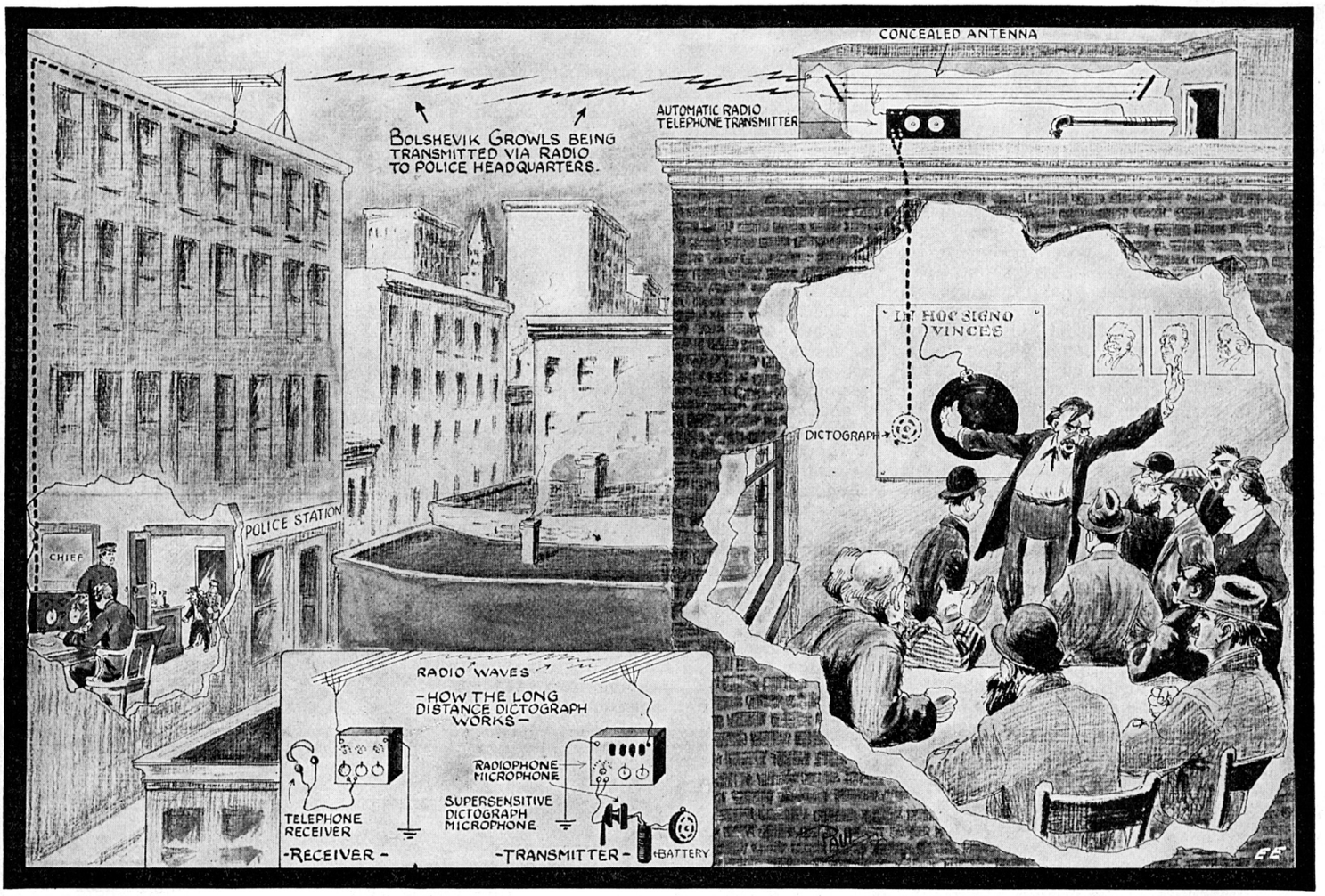
Then with scarcely a glance about Dr. Grieg hurried on into the darker streets toward the edge of the city, where he might have been followed far into the night, walking, walking on and on with the apparent aimlessness of one who has a deal of time to spend and does not find the pastime disagreeable. And yet, if his course was aimless, no one would have described his physical appearance in such terms. First, with his hands deep in his pockets, he hurried along as if in haste from some dreaded pursuer. Then, and apparently without any forethought, he

(*Continued on page* 1062)



". . . Slowly Dr. Grieg Turned the Great 'Medior' Bulb First One Way and Then Another, and Finally He Clamped it Pointing Directly Downward. After Opening One of the Inlet Cocks, So as to Let a Little of the Gray Powder Down Into the First 'Materializer' Bulb, He Watched it Intently for a Long Time. Suddenly He Stopt Sweeping the Rays, and for a Moment He Seemed as One Stupefied. The Iron Bars on Which the Downward Rays Were Playing Slowly Seemed to 'Dematerialize'—Nay, Vanish—Into the Thin Air! The Iron Bars had Disappeared and in the Glass Bulb the 'Golden Vapors' Had Condensed Into a Fine Powder—and it was Distinctly Yellow! . . ."

A Long Distance Dictagraph



The Latest Thing in Dictagraphs Is the "Long Distance Wireless Dictagraph," Shown Here In Actual Use. It Is Not Always Desirable or Possible to Have a Detective or Secret Service Operator Located in the Same Building Where the Dictagraph or Dictagraphs May Be Located in Order to Record any Conversations Picked Up by the Instrument and This Wireless Dictagraph will Undoubtedly Find Many Uses in Police, Private Detective and Secret Service Operations. The Dictagraph Operates the Automatic Wireless Telephone Transmitter Which, Together With Its Antenna, Is Carefully Concealed. The Mutterings of the Much Maligned (?) Bolsheviki Ladies and Gentlemen, Are Thus Hurled Toward the Nearest Police Station at the Rate of 186,000 Miles a Second.

THE *dictagraph* is known to practically everyone today, for this wonderful scientific device has figured quite extensively in all modern detective stories, and in actual police departments and private investigations all over the world. Plainly described, the *dictagraph* comprises a super-sensitive telephone which can pick up at a considerable distance from the transmitter ordinary speech sounds and in some cases even whispers, and transmit the sounds, electrically, over a circuit of considerable length to a pair of telephone receivers worn by a detective or Secret Service operative. The operative who makes use of the dictagraph, and who invariably has to be a shorthand expert so as to record the incoming conversations, is usually located in the same building and in some cases in the room or apartment next to that in which the criminals or conspirators are located.

The dictagraph telephone circuit includes a battery, a pair of low resistance telephone receivers wound to about four ohms each, so as to permit a fairly heavy current to pass thru the circuit, and a very sensitive carbon-grain microphone.

A New York engineer has recently suggested a combination of the wireless telephone and dictagraph, shown herewith in one of its possible applications, and by which means the application and versatility of the dictagraph is increased manyfold.

In a building where the suspected persons have their rendezvous or living quarters, there is installed the usual supersensitive microphone of the dictagraph outfit. This is sometimes hidden behind pictures, under tables, or other furniture, and in some cases it has been placed in the drawer of a sideboard or china closet. The wires are scrupulously concealed and installed by the detectives investigating the case, at some time when the occupants of the apartment are absent. The speech waves picked up by the microphone, are transmitted to the receiver of the loud speaking receiver of the instrument, which is secured in close relationship to the microphone of an automatic wireless telephone transmitter, preferably of the noiseless vacuum type or Audion type.

This latter apparatus is carefully installed in some out-of-the way location where it is not likely to be found, and no attendant is required to stay and watch the apparatus, once it is set into action. This releases the usual dictagraph attendant for more important service. Any conversations picked up by the wireless telephone dictagraph are thus amplified and transmitted in the form of Hertzian waves, from the concealed antenna in the manner shown, whence they are pickt up by the antenna of the radio receiving station located at police or detective headquarters. Here the Bolsheviki's growls and aspirations for running the world are transmitted into articulate speech once more, thru the wireless telephone receiving apparatus, all in a well known manner.

The receiving set can be of the Audion or vacuum tube type and as is the case with all up-to-date radio stations, it may be equipt with a vacuum type amplifier, so that the incoming messages can be intensified until they are thoroly audible, or they may be recorded independently or simultaneously on a phonograph for further reference and record.

At the present time when the United States Secret Service officials are rounding up thousands of the Bolshevist gentlemen and sundry, this "long distance wireless dictagraph" should prove of valuable service. All that is required is to connect up the dictagraph, which is already well standardized and available in the open market at a reasonable cost, to the automatic wireless telephone instrument. This is not the only use of the scheme here illustrated, as there are many others, of course. For instance, why not rig up this arrangement in connection with a phonograph which can have recorded on it the location of the instrument as regards street, floor, room, etc., and in case of fire, the phonograph would be liberated and put into operation, as well as the necessary switches for closing the wireless telephone transmitter circuits. This can be very well carried out in the manner described in a talking fire alarm patent recently granted to a member of the New York Fire Department.

Talking Movies That Talk

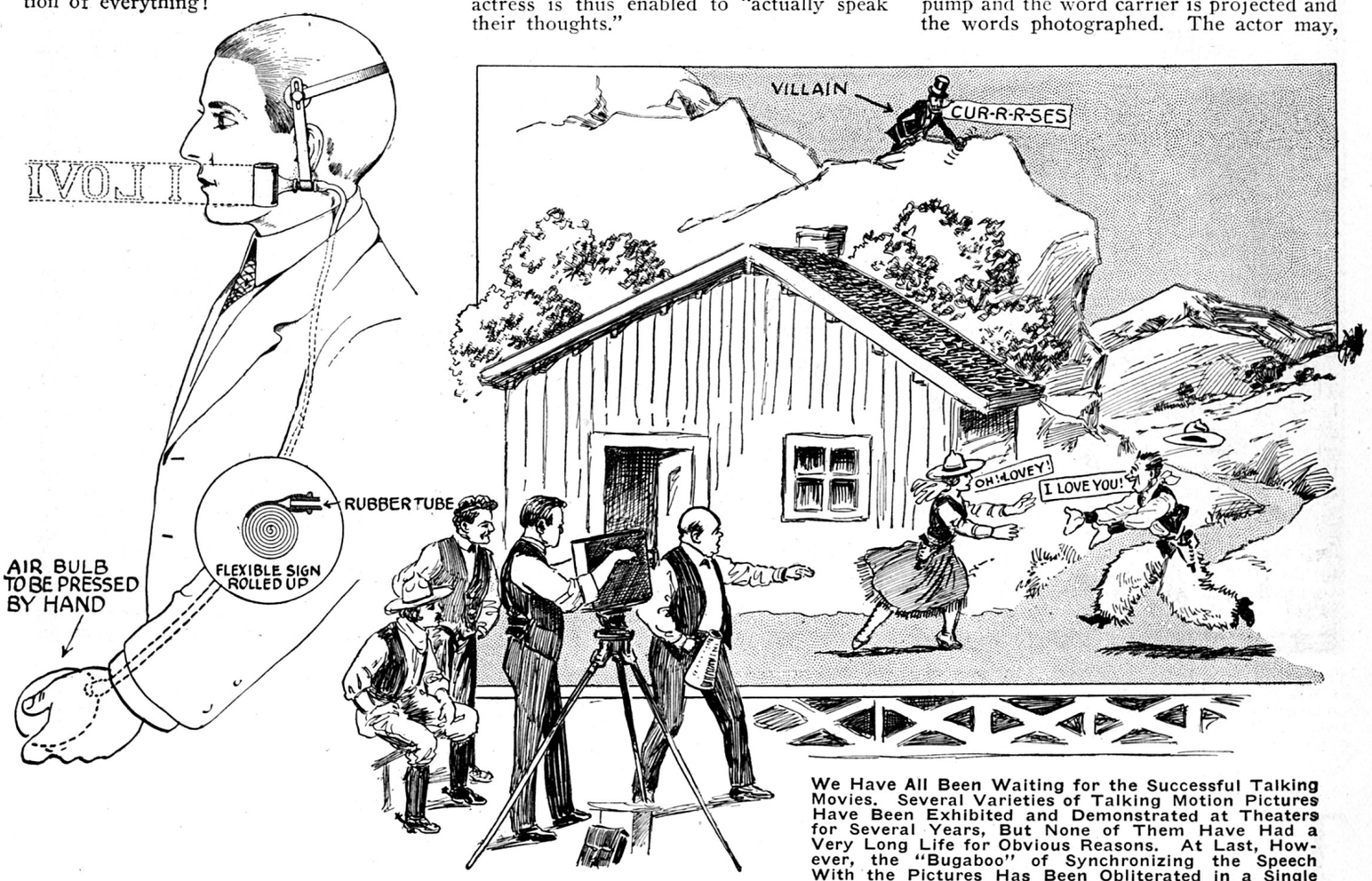
WHILE hundreds of our most eminent motion picture producers and inventors have been working their "thought tanks" overtime—morning, noon and night—trying to produce real "honest-to-goodness" movies that would talk at the right time, with the right accentuation and never, never get out of step or synchronism—lo and behold! Their problems have all been solved overnight, for here comes Charles F. Pidgin of Silver Lake, Mass., with the final solution of everything!

But behold how simple the talking movie is to Mr. Pidgin's mind! Look at the accompanying illustration and you have the whole secret in two seconds! The actors fairly spit out their words to portray their unclassical sayings, and this is accomplished in the simplest manner imaginable. The letters are then printed on a collapsible and transparent celluloid strip which can be extended or contracted by pressing or releasing the pneumatic bulb held in the coat pocket or in the hand, and the actor, or actress is thus enabled to "actually speak their thoughts."

tion, as the actor can actually pronounce the words and produce the necessary facial and mouth movements as the word appears.

Owing to the fact that the film on which the words are printed is transparent, *only the letters* will appear on the developed moving-picture strip.

When the camera is in operation and the point is reached at which it is now customary to interrupt the scene for the introduction of a separately flashed "speech," the actor simply compresses the bulb or air pump and the word carrier is projected and the words photographed. The actor may,



We Have All Been Waiting for the Successful Talking Movies. Several Varieties of Talking Motion Pictures Have Been Exhibited and Demonstrated at Theaters for Several Years, But None of Them Have Had a Very Long Life for Obvious Reasons. At Last, However, the "Bugaboo" of Synchronizing the Speech With the Pictures Has Been Obliterated in a Single Master Stroke of Genius—Let the Actors Speak the Words and Photograph the Words Themselves, as the Diagram Shows Very Clearly. Eureka!

As Mr. Pidgin points out in his patent covering this newly devised movie scheme, the motion picture public is surely tiring of the customary method of exhibiting to the audience now and then, as a six-reeler proceeds on its merry way, short speeches or sentences to give them some inkling as to what Mary said to John—and curses! curses!—what the "villiun" thought about it all.

It is comparatively easy in cartoon and other movie drawings of this nature to show the words issuing from the mouths of the cartoonist's actors, but when *living* actors are employed, there has not been heretofore any method whereby the words could be shown in the scene directly, altho several talking machine schemes have been tried out, including that of Mr. Thomas A. Edison. As is well known, in the *talking machine* scheme, the speeches of the actors are "canned" simultaneously with the photographing of the various scenes and afterward the talking machine record is run off simultaneously and synchronously with the projection of the motion picture. For several reasons this has not been entirely satisfactory, and after having demonstrated this arrangement some six or seven years ago, there has not been any presentation of the talking phonographic movie in some years.

The method of accomplishing these results as described by the inventor consists in causing a selected arrangement of letters which will spell the spoken words to appear from behind the actor, preferably from behind his head, in line with or substantially beside his mouth, while the photographing is proceeding, in order to produce that portion of the photoplay which is to be emphasized by such words or sentences.

Regarding the celluloid strip on which the letters or words are printed, this is made transparent so that the end toward the camera will not unduly contrast with the color of the actor's hair, or otherwise this strip may be colored or made to match his or her hair. The collapsible strip bearing the letters is fitted to a flexible tube leading to an air bulb or bellows which may be operated by the hand or else located under the arm of the actor. When the pressure of air is created by squeezing the bellows or bulb, the quick acting coiled tube is inflated—and out pops the word or words in line with, and apparently from the actor's mouth. As Mr. Pidgin points out, even those in the audience who are experts on lip reading will find this system to be synchronous and very natural in its presenta-

at the same time, for the sake of realism, speak those words which have been prearranged upon the flat tube. He then releases pressure on the bulb which is of that character possessing a normal tendency to expand, and said bulb sucks the air back thru tube and the carrier recedes and recoils itself, so that the exhibited words disappear from the continuation of the film. For a different later speech a change is made in the word carriers. If the action requires the actor to turn around before the end of the scene, the entire device is so easily slipt off that it can be removed during some motion when the audience would not notice the removal.

It will be readily understood that the head piece can be applied so that the word carrier, in normal condition, and the arm, will be concealed from the camera whether the speech is to be delivered to the right or left.

Other forms of word carriers may be employed instead of the coiled type described. For instance, a three-armed rotary member made of transparent celluloid or other suitable material, and bearing letters or words which will compose a sentence when rotated may be easily applied.

The Versatile Audion

By H. WINFIELD SECOR

MANY world-startling experiments in Radio Science have been either directly or indirectly based on the remarkable performance of the *Audion,* the little evacuated glass bulb which greatly resembles the ordinary incandescent lamp, but which contains, besides the filament, two other elements,—a wire grid and a flat metal plate. Some of the most remarkable phenomena in the realm of pure and applied science are due to the as yet not fully understood electronic action taking place within this bulb.

The action in the audion is based on the fact that a heated body, such as a heated filament, radiates millions of tiny electric charges of a negative character or *electrons,* as they are called by the scientist. The wire grid in the audion is placed between the heated filament, which is constantly shooting off the electrons, and the cold plate. When a battery or other source of electric current is connected to the filament and plate, a positive current flows from the cold plate to the heated filament, and this is due to the fact that the electronic flow in any case is *opposite in direction* to the positive current flow. Thus, the hotter the filament, other things being equal, the more electrons there are radiated, and the stronger the current which can be transferred across the space between the plate and the filament, up to the point of saturation.

Now, if we can manage to vary the electron flow between the heated filament and the plate or wing, in some delicate manner, we would have, it would seem, a very sensitive wireless detector, and this is just what Dr. de Forest thought when he first started to develop the audion idea. Suiting his action to the thought, he produced after years of experiment a bulb made in this fashion with three electrodes, one at least of which must be heated. The first grid audion gave results far beyond all expectations.

We may say that today it would really be very difficult to conceive of a single radio or electrical device which is more versatile or universal in its applications than the audion. Some of the more prominent and practical applications of this device are illustrated and described herewith, but it has apparently only just started on its mission of usefulness.

Some of the Many Practical Uses to Which the Audion Has Been Adapted

RECEIVING RADIO MESSAGES.

First and foremost in many ways is the application of the audion, or *vacuum valve,* as it is sometimes miscalled, to the reception of radio messages. The audion will receive and amplify under proper conditions, both radiotelegraphic and radiotelephonic messages. It has the advantage over the crystal and other forms of detectors that, whereas these depend upon the finding of a sensitive spot, often microscopical in size, where the metal wire (cat whisker) touching it proves most responsive; the audion, once the battery currents are properly adjusted to it, keeps right on receiving hour in and hour out.

The action of the audion in this case is along the lines cited in the introduction; that is, one of the antenna circuit wires carrying the incoming signal currents is connected to the grid or intermediate member of the audion. Thus, any variations of electric charge or current on the grid, as would be occasioned by the dots and dashes or short and long signal currents, or else the fluctuations of the radiotelephonic current, causes a corresponding and exactly similar variation in the electron stream passing from the heated filament to the cold plate. It is at once evident, therefore, that as these variations are occasioned by the increasing and decreasing volumes of electric charge on the grid, the current flow from the high-voltage or "B" battery connected in the telephone receiving circuit to the plate, will be varied in correspondence to the grid charge variations. This action is very delicate, positive and accurate, and where more than one bulb is used is of enormously high amplifying character.

For "March"

Sir Oliver Lodge on Atomic Forces. Special interview by H. Gernsback. Don't miss this most important scientific paper in a decade.

New Electric Barge Towing Scheme. By Robert G. Skerrett.

Transmitting Power Without Wires. By Thomas W. Benson.

The Automatic Telephone—How it Works—Without Any "Central." By H. E. Clapham.

A New Tidal Motor—Something New in Natural Power Developments.

How Uncle Sam's Battleships Keep Their Guns Trained on the Enemy by Electricity.

Electricity in Diamond Cutting. By Joseph Kraus.

Big Astronomical Telescopes—Part III. By Prof. Floyd L. Darrow.

Another Scientific Story on par with "The Golden Vapor."

Electrical, Mechanical and Medical Frauds.—Electric Belts, Oxygenators, Foot Pads, Ad lib.—

Energy from the Sun—A new invention by which the Sun's Radiant power is harnest to Man's everyday needs.

Measuring the Growth of Plants by Electricity—A most interesting scientific revelation.

A Day With the Weather Man—An article of interest to everyone.

Radio Amplifiers—Different Types, and Discussion of the best transformers to use in Audion Circuits. By Ensign Pierre H. Boucheron, U. S. N. R. F.

The "Finer Workings" of Static Electricity—Part II. By Frederick von Lichtenow.

The Secret of the Magnet Poles—How the Magnet Works. By Walter E. Keever.

Gaseous Telephone Transmitters—A startling new invention of extreme simplicity. By Richard A. Engler.

The audion, with slight circuit modifications, can be used for receiving both damped and undamped radio signals and therein lies one of the most tremendous advantages of this device. By the mere turn of a switch or readjustment of the circuit the audion can be made to oscillate and receive either damped or undamped radio signals equally well. This was of inestimable service to the Allied armies and navies during the war, as may be readily imagined, and audion sets were built by the thousands, and the consumption of bulbs by the Allied armies and naval fleets was at the rate of 1,000,000 per year during the last months of the war. See figure 1.

AUDION CAN TRANSMIT MESSAGES.

At Fig. 2 the audion is shown in use for transmitting wireless messages. It can and has been very successfully used for sending radiotelegraphic and radiotelephonic messages. Usually, but not in this case, the audion for this apparatus is made of a somewhat larger size; the average audion such as that used for receiving apparatus is about the size of a 30 watt tungsten lamp, but the bulb is tubular in form and not pear-shaped. The French audions, however, resemble the average Tungsten lamp shape, while the German types are tubular.

It was found in various experiments that the vacuum tube of the audion type; that is, under certain circuit conditions, and where a sufficiently high voltage direct current (such as that produced by a 500 to 800 volt, D.C. dynamo) was applied to the plate, that the bulb action took on an oscillating nature and caused a radio-frequency alternating or oscillating current of an undamped form to be produced. By simply connecting up a microphone in one of the circuits, for which there are now several different schemes available, it thereupon became readily possible to easily and perfectly modulate this converted radio-frequency oscillating current produced by the audion into speech currents, which can be radiated from the antenna in the form of Hertzian waves and picked up at any wireless receiving station.

Several years ago the first trans-Atlantic wireless telephone speech was transmitted successfully, thanks to several hundred large oscillating audions, which were connected up in a common bank in the government high-power station at Arlington, Va. Just to show how easy it is to control 50 or 100 K.W. of energy as produced by a bank of audions such as this, it may be mentioned that an ordinary microphone, such as we have in this case, can readily modulate or control telephonically the entire bank of bulbs, totaling 15 K.W.

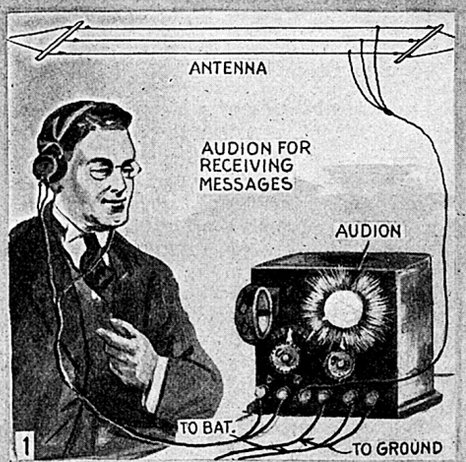
During the war many of these audion transmitting sets with one or more bulbs on them were designed and built for the American and other Allied armies. The U. S. Navy Department, as well as the aircraft divisions of both army and navy, have also found the audion bulb transmitting sets of inestimable value, both for transmitting radiotelegraphic and radiotelephonic messages.

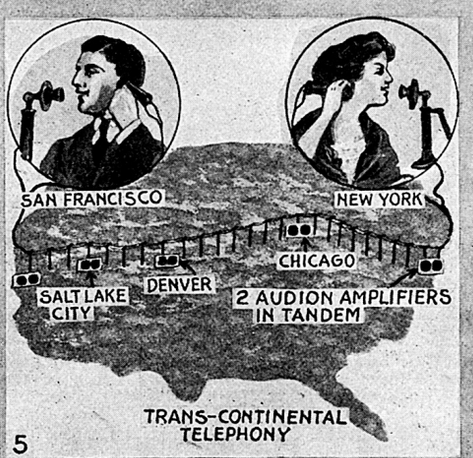
RADIO AMPLIFIER.

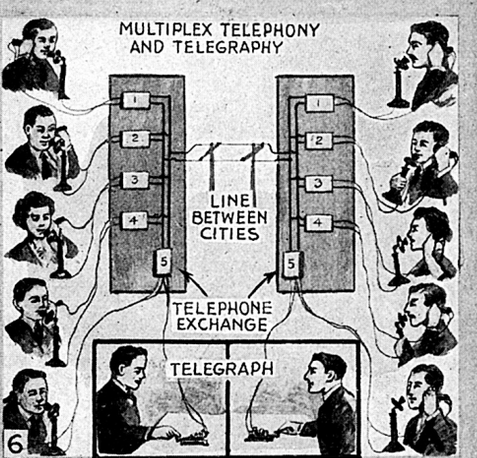
The audion as an amplifier of radio signals, either telegraphic or telephonic, has proven to be far in the lead of any other form of amplifier ever devised. It is not to be inferred from this statement that there are not available at the present time several very interesting and very useful forms of electro-magnetic amplifiers, for there are several which possess meritorious features, indeed,—but the audion is unique in that, with very simple circuit arrangements, one can keep on connecting up audion bulbs until they have amplified the faintest imaginable signal or spoken word, until it roars forth with the strength of a hundred horses. Practically every army and navy station today is equipt with an

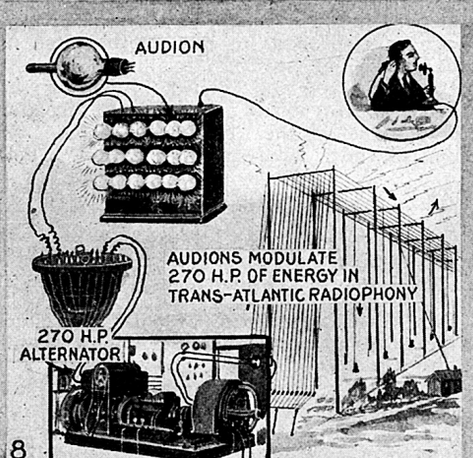
(*Continued on page* 1080)

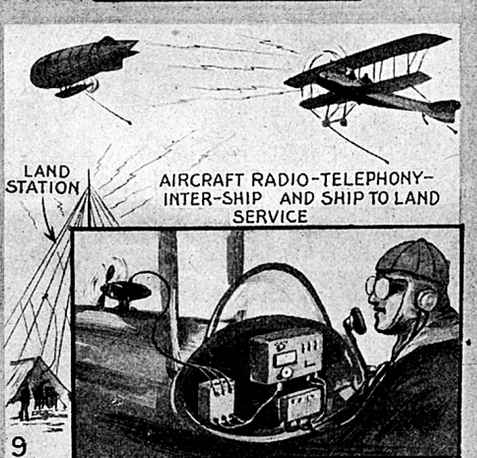
AUDION APPLICATIONS

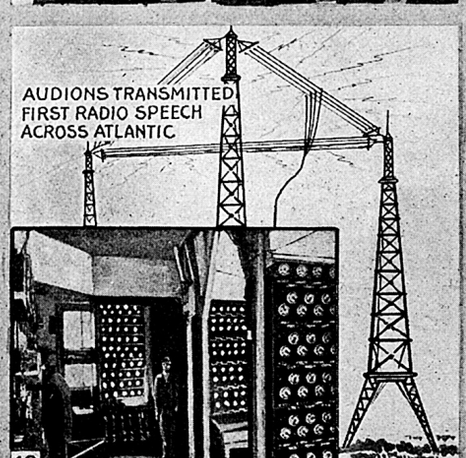


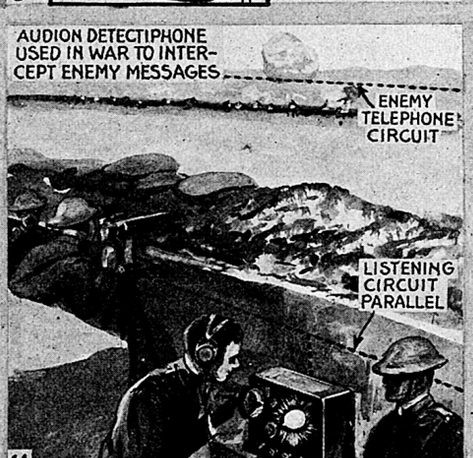


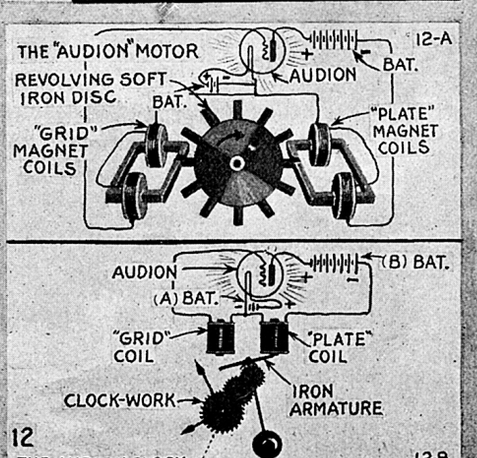












Copyright, 1920, by E. P. Co.

(COMPLETE STORY ON OPPOSITE PAGE)

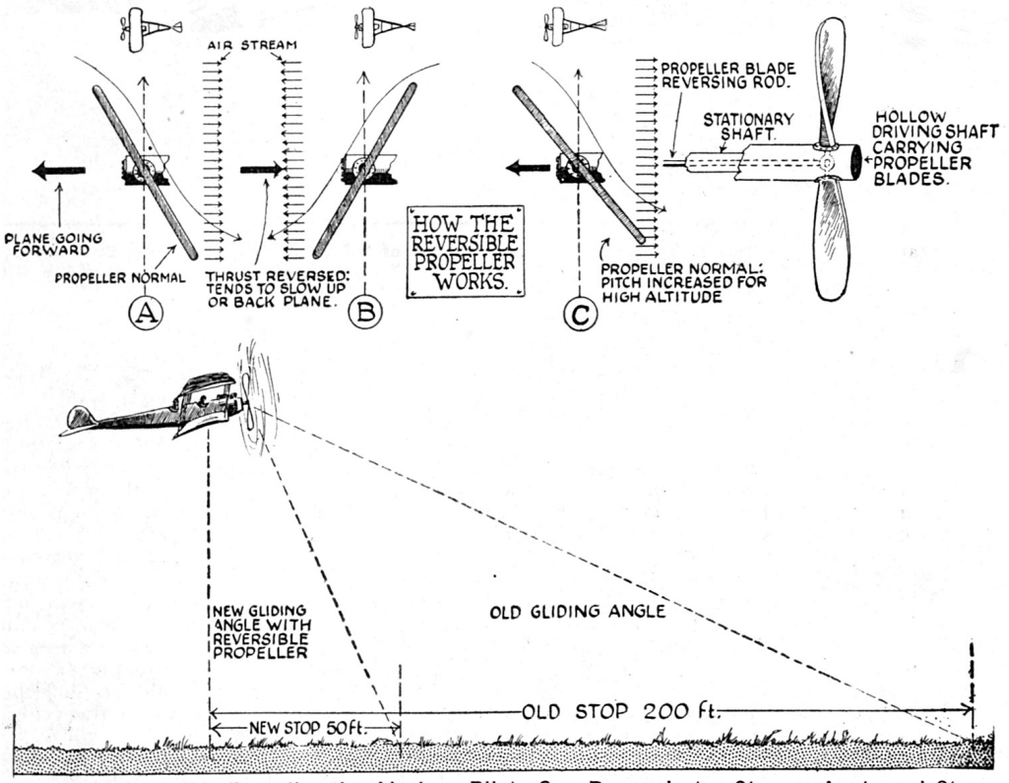
Reversible Airplane Propellers

ANNOUNCEMENT from McCook Aviation Field, Dayton, Ohio, in the latter part of October, stated that successful tests had been made with a reversible airplane propeller, which means, according to experts, that the day of the "backyard" airplane is here.

With the new propeller, airplanes can land and be brought to a stop within 50 feet by actual test, it is said.

The new device will also increase the climbing speed of an airplane 40 per cent and permit of higher altitude flying, 50,000 feet being a possible limit. Seth Hart of Los Angeles, Cal., is mentioned as the inventor of the new reversible propeller.

The accompanying diagram chart shows how the reversible propeller functions. Normally, it is regulated by suitable mechanism controlled from the aviator's cockpit, so that a medium pitch is obtained at the blades, as shown at Figure "A." When the speed of the plane is to be reduced, the *pitch control* rod of the propeller is varied so as to *reverse* the pitch of the blades, as at "B," thus reversing the stream of air, and likewise lowering the thrust or forward pull on the airplane. This gives us the "backyard" plane. At high altitudes where the air is thin, a better "hold" is obtained by the tractor screw by increasing the pitch, as at "C".



With the Reversible Propeller the Airplane Pilots Can Descend at a Steeper Angle and Stop in a Shorter Distance Than Ever Before. It Also Allows Him to Increase the Pitch of the Propeller at High Altitudes, Where the Air is Thin.

Dr. William Whitney Christmas, the inventor of the "Christmas Bullet," the fastest plane in the world, with a speed record of 200 miles per hour, had the following to say on the performance of the "Reversible Propeller":

The Possibilities of a Reversible Airplane Propeller

For a period covering probably five years there has been more or less discussion along the line of *reversible propellers* on airplanes. The prime practical factor in the correct building of an airplane is as few parts as possible in its construction. Any kind of mechanism which has a multiplicity of parts must necessarily run a greater risk of disintegration than a device which has fewer parts.

There are several inventions, it is believed, which have to do with changing the pitch of a propeller on an airplane while the plane is in flight. These inventions have also included means for a reversing propeller for the purpose of quick landing in small areas. The difficulty with such devices has been that the mechanism which controls the blades has been found to be both weak and uncertain in its operation. Centrifugal force plays a most important part in such a device because this force is astonishingly great and must be reckoned with under all circumstances. Centripetal force also has its important bearing on the case and it has been found from experience that these two forces have a most decided disposition to defeat the intention of the designer and inventor of any device which has to do with changing the pitch and reversal of the propeller blade.

Undoubtedly if such a device could be made practical, it would go a long way towards solving some of the bad features of airplane landing, but it is not within the limits of reason to attribute certain features to this device which cannot be accomplished.

A plane must have what is called a *gravitation index*. This gravitation index varies in different planes and concerns both

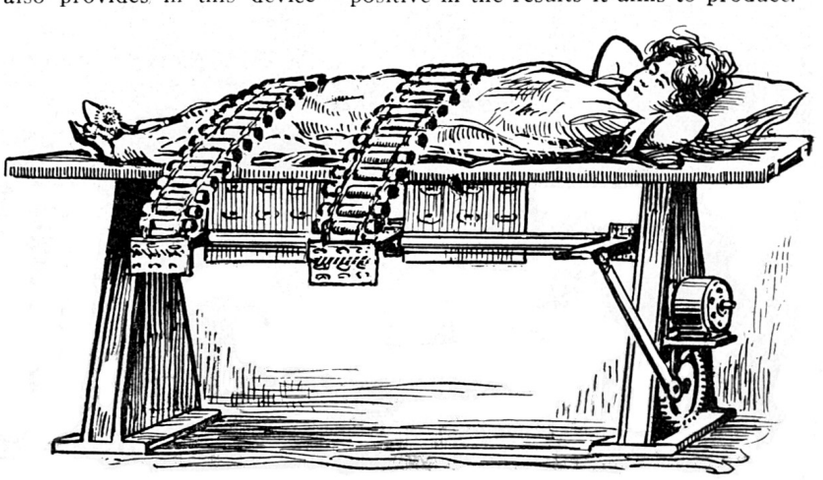
(*Continued on page* 1087)

Making Fat People Thin By Electricity

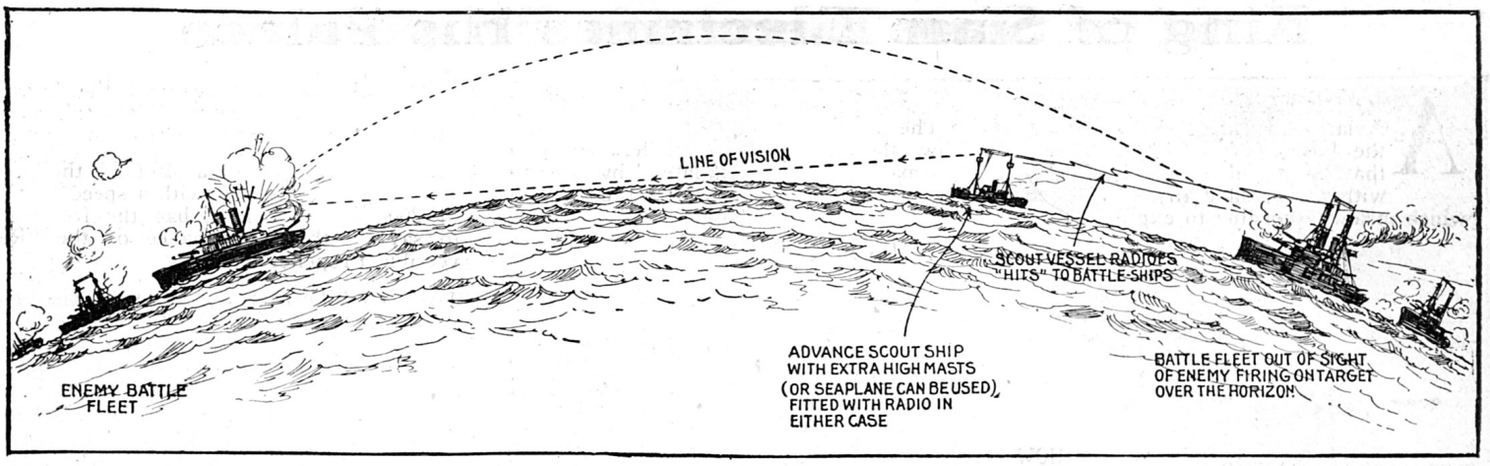
IT has remained for a woman, Fanny J. Niles, of Philadelphia, to invent what she calls a "normalizing machine," which comprises a clever electrical massaging machine adapted to massage the fatty tissue or superfluous flesh on any part or the whole of the body. Massaging members comprise two strips of wooden rollers or bars mounted on flexible belts, so that they can be supported by and also secured to the two opposite sides of an oscillating frame. In this manner the bars can be moved to and fro more or less rapidly as desired.

The belts at the ends of the series of rollers are connected by pins passing thru flexible sheets, made for instance of heavy canvas or other strong material, in which there are a plurality of eyelets. These eyelets pass over a series of turned buttons, and thus it is seen that by providing several series of eyelets in the sheets at the ends of each series of rollers, that a wide range of adjustment is provided so as to give the necessary pressure on the body, and thus enabling the physician or person giving the treatmcnt to adjust the roller sheets so as to conform to the shape of the patient's body.

A small electric motor drives the machine thru the medium of a set of reduction gears in such a manner that a frame to which the roller belts are connected will be given an oscillating movement. Thus the rolls are more or less rapidly oscillating over the body and the speed of this massage movement may be regulated by controlling the current supplied to the electric motor. The inventor also provides in this device a feature whereby varying widths of belts carrying the rollers may be used as desired; also two or more roller units may be used on the patient. This type of machine has been in use for several years with great success in several electrical treatment institutes in the East. The machine is simple in its functioning and sure and positive in the results it aims to produce.



Are You Too Avoirdupois? Just Step Up and take a Treatment Now and Then on This Electric Normalizing Machine, Which Massages the Superfluous Tissue From the Body. This Machine Has Been in Use and Gives Excellent Results.



This Explains How It Is Possible to Shell Enemy War Vessels Which Are Over the Horizon or Out of Sight of the Attacking Battle-fleet. A Scout Vessel Provided with Extra High Masts for Spotting the Enemy, Is Sent in Advance of the War Vessels and Radioes Back the Results of the "Hits," or Else a Seaplane Can be Used for the Purpose, and in Either Case, with Deadly Results to the Enemy.

Hitting Invisible Targets

MANY times during the recent world war one would often read in magazine and press articles of various naval engagements where vessels were hit by shellfire over the horizon and out of sight of the vessel firing the shell! One of the ways in which this can be done and which was recently explained to the editors by a U. S. naval officer, is shown in the accompanying illustration.

At the left we perceive an enemy battle-fleet just over the horizon and out of sight of the attacking battle-fleet. Naturally, unless the gunners behind the attacking war vessels know exactly where the enemy is located, they cannot fire a shell to hit his ships. To gain this information, there are several possible ways in which it may be done. One of the practical methods which has been employed is here shown.

A fast scout vessel such as a battle cruiser, goes ahead of the main battle-fleet and for special observation it is fitted with an extra high mast, so as to have the greatest range of vision possible. When the lookout in the crow's nest atop the scout ship's mast spies an enemy vessel, he immediately radioes this fact to the battleships and they begin firing. The officers on the scout vessel can with their powerful telescopes, easily determine whether the shots are passing to the right or to the left, or to the rear or in front of the enemy target or targets, and this information is instantly radioed to the attacking battleships. Seaplanes from the battleships themselves can also serve the purpose of the scout ships in spotting the effect of the gun fire on the enemy, as well as discovering their position.

It may be easily imagined that a seaplane at an altitude of several thousand feet and provided the atmosphere is fairly clear, has a wonderful range of vision toward the horizon. Naturally, the question arises as to what would become of such a scout ship, the mast of which could be undoubtedly sighted by the lookouts in the crow's nest of the enemy war vessels.

To make a long story short, there are

(*Continued on page* 1087)

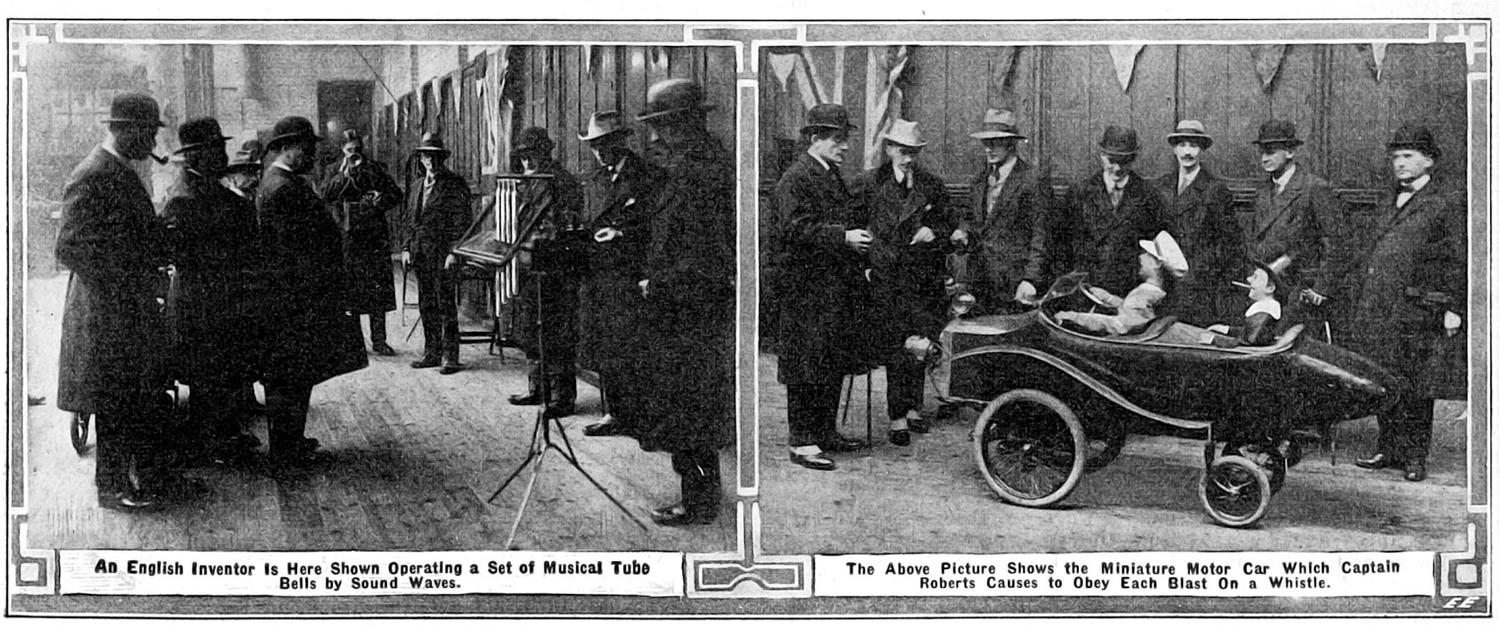
His Whistle Stops Auto

BY means of a whistle a miniature motor car, containing two lay figures, was run, stopt and turned at the will of the whistler in a hall off Tottenham Court road recently, in England.

Further, by the influence of a ray of light the mustache of one of the lay figures twitched and its hand moved rhythmically, while in a corner the Westminster chimes rang out on an instrument.

The magician who produced these wonders was Captain Alan Roberts, an Australian. After long experiment he believes he has perfected apparatus for control by light and sound waves. One of the photos herewith shows Captain Roberts starting and stopping a mechanical musical instrument (tube bells) by means of a ray of light. This photo was taken in the Drill Hall, Chelsea Street, W. C., London. The second photo shows Captain Roberts demonstrating his new invention, the small motor car being entirely controlled by the sounds from a whistle.

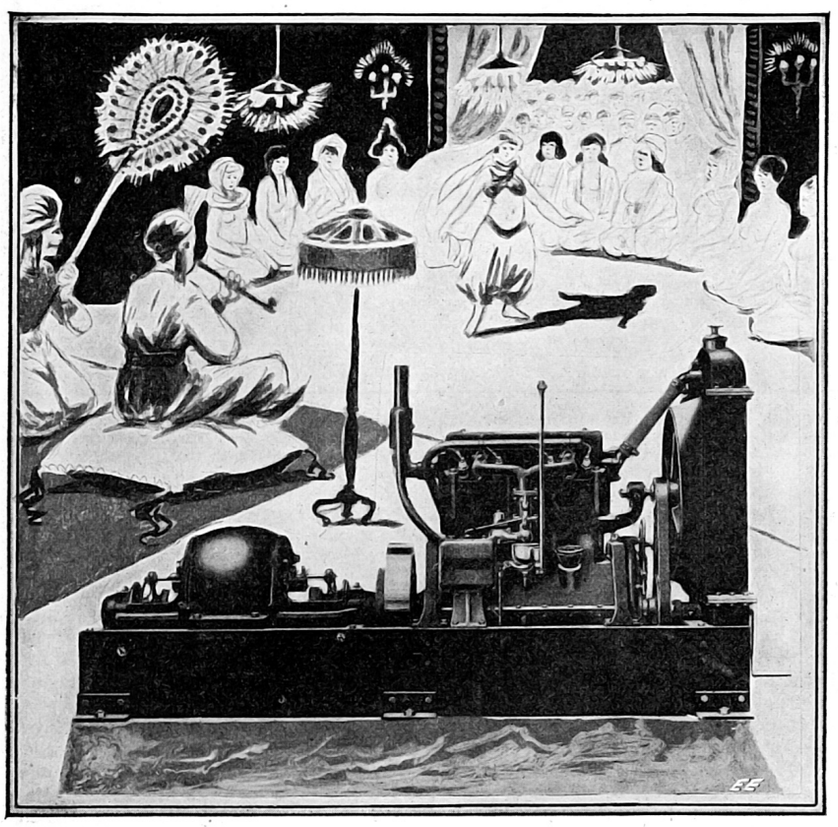
Captain Roberts gave a demonstration on the possibilities of light and sound control. Standing in the middle of a crowd of men, Captain Roberts blew a blast on an ordinary police whistle. Immediately the electric motors of the car began to hum, and the little vehicle in which was seated two models slowly glided across the floor. He blew another blast and the car stopt, turned around, glided deftly past chairs and apparatus and finally moved slowly back to its starting place. By turning a beam of light on and off, a gong was made to sound at will and by blowing on whistles of different keys, little electric bulbs were lit up thirty yards away.



An English Inventor Is Here Shown Operating a Set of Musical Tube Bells by Sound Waves.

The Above Picture Shows the Miniature Motor Car Which Captain Roberts Causes to Obey Each Blast On a Whistle.

King of Siam Electrifies His Palace



The King of Siam, Among Other Recent Acquisitions to His Palatial Home, Has Added an American Lighting Plant, Which is Shown in the Picture Herewith. This Electric Lighting Plant Is Driven by a Gasoline Engine, Similar to an Automobile Engine, as Shown in the Illustration and It Is Rated at 5 K. W. Electric Output. This Electric Light Plant of Which a Large Number Have Been Sent Abroad the Past Few Years, Is Interesting Owing to Its Full Automatic Features. A Gold-plated Typewriter Was Also Purchased on This Trip, but History Doth Not Record Whether or Not the Dynamo Was "Gold-plated."

HIS Majesty the King of Siam, recently purchased a 5 kilowatt electric plant to furnish light and power for his luxurious royal palace. The special representative sent by His Majesty spent considerable time investigating many factories and in studying the features of the various plants on the market, and because of its full automatic features the latest type full automatic plant, illustrated, was selected. On this same American trip a *gold-plated* typewriter was purchased. History doth not record whether or not the dynamo was gold-plated.

A 10 kilowatt electric light and power plant of the same type was recently shipt to Rene Berndes, who is the ex-Hungarian consul for Cuba. Señor Berndes has recently gone into the sugar business and has an immense, modern plantation which requires an ample installation for both light and power.

The Presidential train of the Republic of Mexico, renowned as perhaps the most elaborate train in the world, presented by the Pullman Company to the Mexican Government, has just been equipt thruout with electric lights and one of these full automatic plants was installed. This train was presented during the regime of ex-President Diaz and has been in constant service ever since. It is most lavishly decorated and finished without regard to expense, several of the interiors being trimmed in gold-leaf, with intricate and classic hand carvings, and inlaid with ivory.

These plants are the same as are used thruout America on thousands of farms, but are of larger models. The patented full automatic features make it a most popular plant where reliable service is expected. It gives the battery full protection at all times against over-charging or excessive discharge. It starts and stops itself automatically. These plants are built in seven sizes—from 1/3 to 25 kilowatts.—*Photo courtesy Consolidated Utilities Corp.*

Lighting the "Big Top"

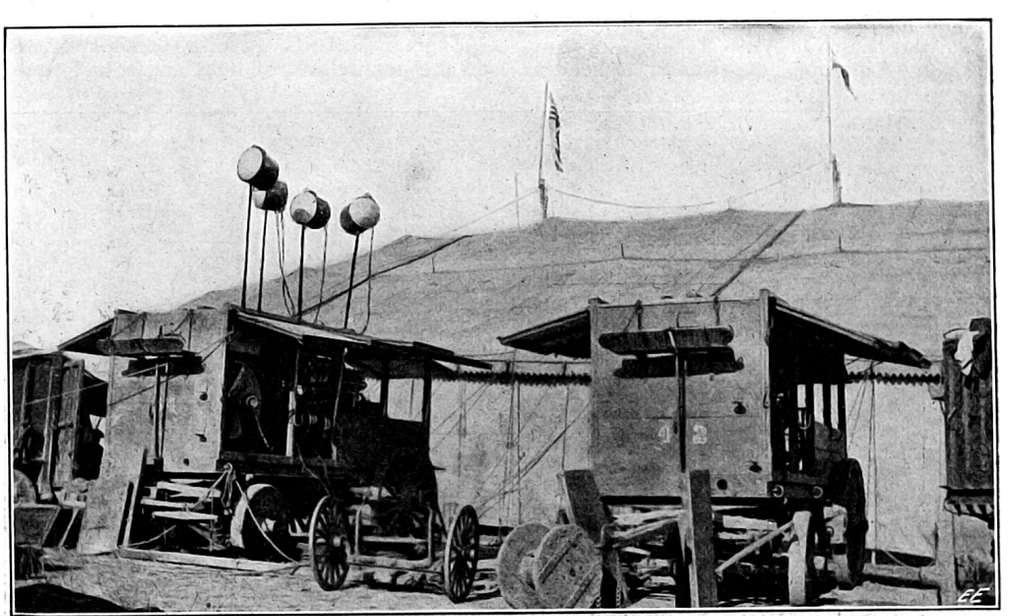
Nowadays when the Circus comes to town, at least if it is one of the big fellows like Ringling Brothers and Barnum and Bailey, the "big top" and the "side show" and the "menagerie" are all electrically lighted. The old-time, dangerous flares are not to be seen in the tents where the crowds are entertained. As soon as the canvas is in place and guy-ropes are tightened the electrician appears to hang his lamps upon the poles. Then his helpers bring in wheeled reel-holders containing the heavily insulated feed lines, run the wires out, and finally connect the terminals to the generating plants outside the "big top."

These portable sets are mounted upon ordinary circus wagons, well built to stand the continuous wear of country roads and city pavements. Each unit consists of a four-cylinder gasoline motor, of seventy horsepower, turning a twenty-five kilowatt generator and making 120 volt current. Then of course there is a switchboard. Each unit uses three gallons of fuel per hour operated.

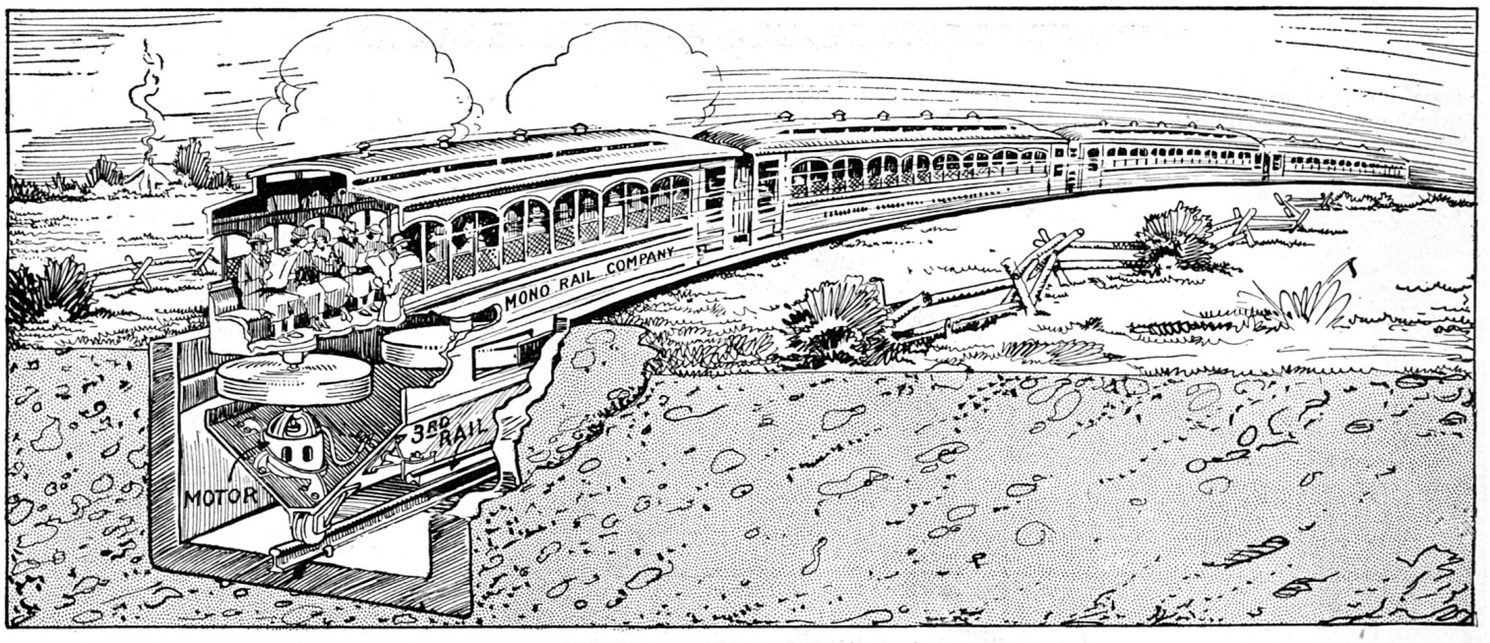
The "big top" contains twenty-four big arcs, twelve 750 C.P. lamps and twelve 500 C.P. lamps. The "side show" and "menagerie" tents have fewer lamps because they are much smaller. For afternoon shows only the "big top" is lighted but in the evening the electrician opens up with all the juice he has in stock. Needless to say, electrically lighted tents are safer than those lighted by any sort of combustion system. In addition the grounds may be illuminated by using the flood lights placed upon one of the wagons. Yes, it sure is some change from our fathers' and grandfathers' day when they used to chew peanuts and drink pink lemonade by the flickering light produced by a series of kerosene or gasolene torches. Later, there came into use the very efficient but always dangerous acetylene gas lighting systems, while at the present time most of the traveling shows "under-canvas" employ electric lights exclusively. If they do not carry their own electric light generating plant, then they invariably procure the necessary electric current from the local town supply.

Generally speaking, the most satisfactory method of lighting "tent shows," would seem to be the one utilizing the independent lighting plant of the type illustrated below. Some smaller tent shows, have made use of storage batteries having these charged periodically,—but without a shade of doubt the most efficient and satisfactory way, is to have a suitable size dynamo, driven by a gasoline or other form of engine. With the advent of the modern high-powered tungsten lamps with nitrogen filled bulbs, the tent lighting problem has been much simplified as some of these bulbs are available in 1,000 candle-power units, which corresponds to the illuminating power of the average arc light.

Contributed by G. B. WOODS.



The Circus Will Soon be with Us Once More, and In the Event That You Do Not Know Where the Electricity Comes from for Lighting the Immense Tents Carried by Such Shows as "Ringling Brothers," Here Is the Answer—Complete Electric Lighting Plants Driven by Gasoline Engines Are Mounted in Trucks. The Flood Lights Seen on Top of One of the Trucks Are Used for Lighting the Grounds.



A Newly Proposed Monorail Rail-road, One Form of Which Is Here Illustrated, the Cars Traveling in a Trench and Being Propelled by Friction Wheels as Shown, or by Gears Meshing with Toothed Racks. The Propelling Wheels Are Driven by Electric Motors and Procure the Necessary Current from a Third Rail. The Monorail Is Reputed to be the Fastest System of Transportation.

Novel Electric Monorail Car

It is a well-known fact that cars placed on a single line of wheels will run much faster than if placed on a double rail as at present, and it further follows that if a car or locomotive can be made to run on a single rail in a normal, stable and upright position, it must necessarily travel faster than the ordinary trains, at the same time using an equal amount of fuel or electricity. So says Max Scheftel, of Brooklyn, New York, the inventor of the new monorail shown in the accompanying illustration.

Mr. Scheftel proposes two different methods of applying his monorail railway system. In either case the cars run on a single or monorail track as becomes evident. Electric current for propelling the cars may be taken either from a trolley wire or a third rail, and the current returned thru the center monorail on which the cars run. The cars may be propelled, according to Mr. Scheftel, either by having an electric motor or motors drive large friction wheels which protrude thru openings in the sides of the car, so as to buck against flat friction rails on the sides of the trough in which the cars run, or else they may be operated by gear wheels protruding from the sides of the cars, which gears may mesh or engage two toothed racks placed along the sides of the conduit.

The latter undoubtedly would make a very severe noise and prove objectionable, excepting for some short run railway such as a scenic railway or roller coaster.

The inventor has designed the cars with a tapering bottom and other mechanical features, so that they will permit the car to run with the utmost efficiency and at the highest speed possible.

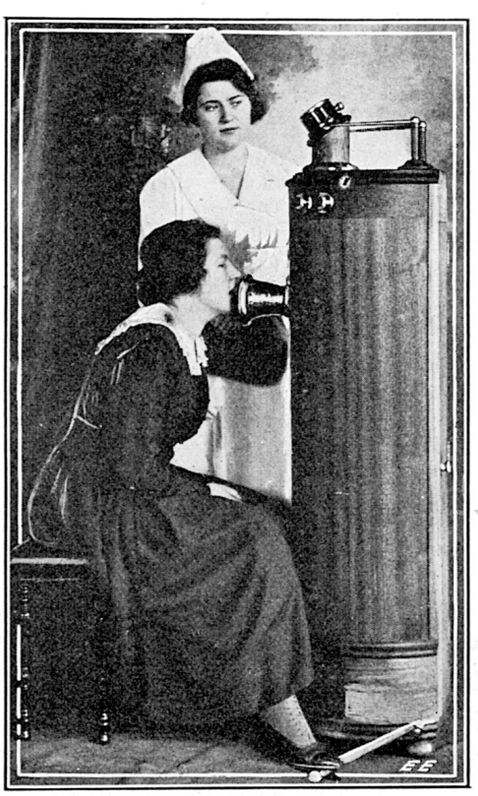
In cities where the building of such excavations is not permitted, the inventor describes a different construction for the cars and trackage, which is made of structural steel upon the level of the street, the center monorail on which the car travels being laid on the street surface. In this case the guide rails on the sides are supported by structural steel arches.

Had Your Teeth X-Rayed?

Here's the newest dental X-ray machine. It's noiseless, yet extremely powerful and rapid, requiring a minimum exposure period. Relative to the technique of taking dental X-ray pictures, it naturally requires a film or plate behind the portion or parts of the body to be X-rayed, but the advantage claimed for this machine is in the time and milliamperes required for making an exposure.

Exposures on all machines are figured in milliampere seconds. This, being arrived at by the time of exposure, multiplied by the milliamperes. In other words, with a meter reading of 25 milliamperes and an exposure of 4 seconds, it would give an exposure of 100 milliampere seconds. Where other machines operate on anywhere from 50 to 150 milliampere seconds, this machine operates on from 4 to 8 milliampere seconds.

The current is turned on and off by the foot treadles operating from both sides of the machine.



Have You Had Your Teeth X-rayed? That Is the Question You Hear Everywhere Today, for Our Best Dental Experts Aver That No One Can Tell Just What the Trouble with Our Teeth Is Until They Look Thru Them as Well as At Them, by Utilizing an X-ray. One of the Latest Dental X-ray Machines Is Shown in the Accompanying Illustration. This Machine Is Very Powerful and One of the Highest Speed Types Yet Devised, Yet It Is Simple to Operate and Does Not Frighten the Patient. The Position of the Patient Is Shown Herewith When Taking a Skiagraph of the Teeth. A Foot Pedal Turns on the Power.

The matter of safety is one that must be looked into very thoroly. In this machine the tube on the inside is completely incased in a *lead casting*, which shapes out into the funnel from where the exposures are made, giving absolute protection as far as the operator of the machine is concerned, there being no chance for the rays to escape except thru the opening in the funnel. As to the safety for the patient the low milliampere-second exposure is again the big factor here. According to the best authorities on X-rays, it takes a minimum of 800 milliampere-seconds directed at the same spot to cause X-ray burn. It is readily seen, therefore, how much leeway this outfit has over a machine using 100 milliampere-seconds to an exposure, as compared to 4 milliampere-seconds here required. The lead covering of the tube also protects the patient on all parts of the body except just where the rays from the funnel are directed, or in the region of the teeth.

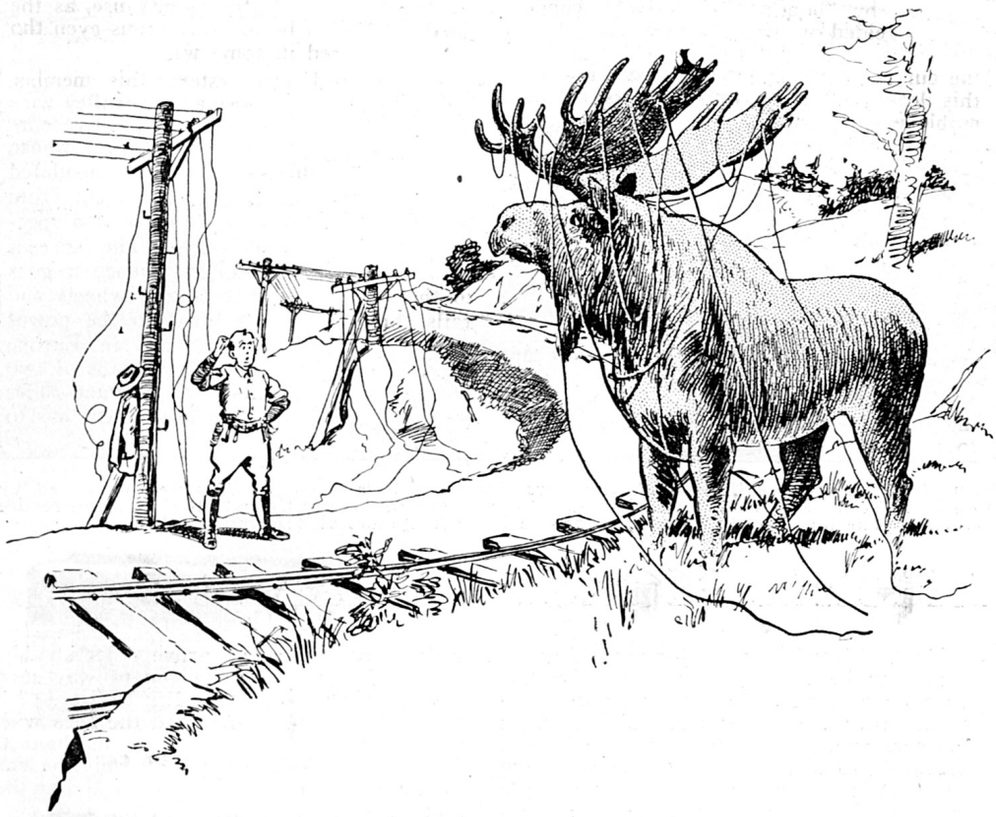
"Bull Moose" Steals Wire

Any sportsman from the big cities who finds a bull moose running around in the neighborhod of Wassataquoik stream with 40 or 50 feet of telephone wire coiled around his neck and horns, and a loose end trailing ten or fifteen feet astern of him, is hereby informed that the wire belongs to the Lincoln Pulpwood Co., of Lincoln, Me., and that the moose stole it and thus put the line from Trout Brook to Bangor, Me., out of business for a while. Herbert S. Stone, of Bangor, lineman for the company, tells how it happened in the following realistic tale:

"I had just got to McCarty's camp at the head of Trout Brook when the boss told me that there was an open wire between there and Staceyville. As this is the direct wire to Bangor, down over Pogy Mountain and by way of Wassataquoik, I rustled some grub and struck out to find the break. Got to Pogy same night. All right there. Followed the wire down to Wassataquoik and from there to Halfway Camp at the mouth of Katahdin Brook, where I arrived the next night. Still no break. Next morning I took up the trail again and a couple of miles down, near Daisy Dam. I found the slack wire and the break, but to my surprise I could find but one end. Hustled along looking for the missing end and finally found it 500 feet further on. What had become of the missing 500 feet? There I was, two days' travel from headquarters camp, with only about 50 feet of wire on my back, for short splices. Fine fix! I sat down on a stump and finally thought of an abandoned branch line that once connected a lumber camp two miles further along. Went down there and got enough wire to fill the gap.

"When I got back to the break in the line I soon found out what had become of the missing 500 feet. There stood a bull moose as big as a truck horse, looking straight at me as much as to say: 'Here's your old wire. Come and get it.' Well, so long as I'd hoofed it better than four miles to get my wire I thought I'd repair the break and argue with the moose afterward. The job was soon done, and after I had called up Staceyville on one end and McCarty's camp on the other and told them all was clear, I turned to the moose, having first picked out a handy tree to climb in a rush should the bull get too fussy.

"There stood the moose," he said, "just at the edge of the road, with six or eight turns of the wire twisted tightly around his horns, several turns around his neck and three or four hundred feet of slack behind him, reaching, Lord knows where, into the woods. Sneaking around, the moose watching me all the time, I managed to get hold of the slack wire and hauled in until I got the end, which I made fast to a big tree. Then cutting a good-sized sapling, I started toward him. He began to sidle around, with head down, mane bristling and blood in his eye, and it looked like war. Pretty soon, however, he managed in his circling movement to make a turn around another tree, which gave him much less scope, and when the wire came taut with his contant traveling he stumbled over it and fell in a heap. Now was my chance. I sneaked up as close as I dared—maybe within fifteen feet, snipt off the wire with my pliers and made for my tree."



It Sounds Impossible, Doesn't It, That a Real "Bull Moose" Should Walk Off Very Mysteriously with a Goodly Length of the Telephone Wires and Leave a Complete Gap in the Pole Line? But, This Actually Happened Up in Maine, and as They Have Had "Prohib" in That State for Many Years, It Must be as True as Gospel. Friend Moose Reappeared After the Gap Had Been Repaired.

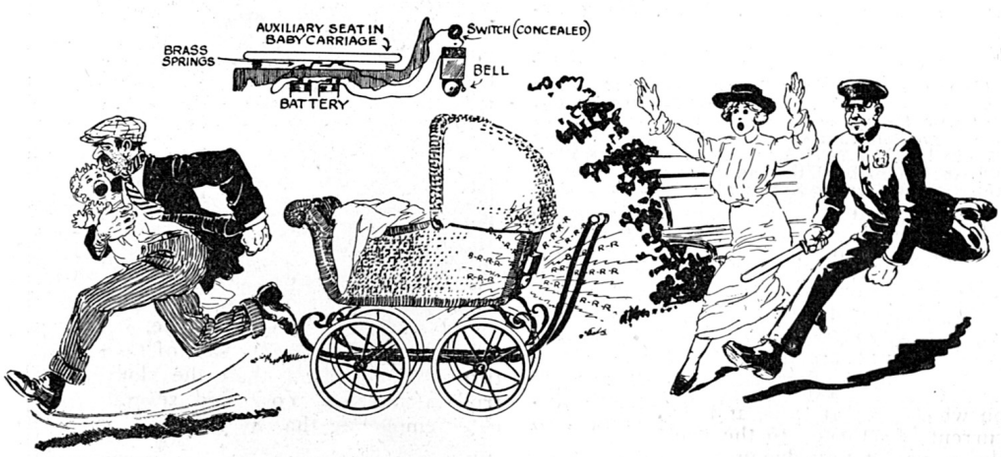
Electric Bell Foils Kidnappers

Dozens of babies are kidnapt or stolen every year, especially in the large cities, and while electric bell alarms have been with us for the past fifty years, no one has ever thought, it seems, of putting such an electric bell alarm on the baby carriage.

Now, Nursey can spoon on the park bench with her friend "Mike The Copper" to her heart's content, without having to worry herself into a French fit whether the baby is or is not within the carriage, several yards distant. For never fear, Snookums will be there!—when she goes to look for him—thanks to this electric alarm.

The diagram shown in the accompanying illustration explains in a clear manner, the simple way in which the electric alarm is attached to the baby carriage. As will be seen, when the infant is lifted from the seat, the springs under it push it upward, causing the electrical contact springs to come together, thus closing the electric circuit thru the dry battery and bell. An ordinary 25-cent bell, together with a dry battery or two, is all that is required. A hidden switch of course, should be placed in series with the circuit as shown, so that the bell will not ring unnecessarily.

We should certainly be thankful to the budding genius who has presented us with this "long felt want"—and now we shall expect to be presented with a multitude of other greatly needed electric alarms. Why not tie one of these electric thief announcers to little Fido's neck or better yet, to his tail. Of course it would take quite some study to find just which part of Fido will respond or move in an unusual direction when a stranger happens to pick him up. Possibly, however, this can be arranged in the form of a harness with a handle, said handle being made in two parts with electric contact springs between them, so that when the handle is grabbed, it will cause the springs to touch, thus ringing the bell. "Doggone" that sure is a clever invention, if we do say it ourselves. But what if he uses a net!?XO?



No More Will the Naughty Kidnapper "Nap the Kid,"—Not While the Electric Bell Alarm, Here Shown, Is In Working Order on Little Snookum's Go-cart. Isabel and Her Friend "Mike the Copper" Will Make It So Hot for Him That He Will be Glad to Give Up the Kid and Take a Nap.

Trolleys We Have Met

IN OUR travels here and there about the country, we have often met some interesting electric trolley cars and some of these impressions we have attempted to record in the accompanying illustration. It is perhaps rather interesting anyway, to the average layman, to know for a certainty just how the current is taken into a trolley car of the ordinary type, down the trolley pole, thence thru the controller and motor on the car axles or truck, and how the current passes back thru the rails to the power station.

THE SINGLE WIRE TROLLEY.

This is the simplest form of electric trolley car and one which has been used not only in the United States, but in practically every civilized land under the sun. They are even now talking of electric trolleys in the Holy Land, and we presume that before many moons have past over our heads, they will have a trolley running up the corners of the great pyramids of Egypt and climbing the grades of the Sphinx's nose in the far-away land of Cleopatra. Thus, the trolley has its romance as well as its seamy side in history. And here is how it all works!

One wire from the trolley power station is connected to the overhead insulated trolley wires and this is usually the positive line. The potential used on the average trolley is from 550 to 600 volts, direct current. This current passes along the wire, thru the trolley wheel and pole, from which point it divides and passes thru the lights and heaters on the car, which are controlled by suitable switches, while the heaviest part of the current is carried thru heavy insulated copper wires down to the motorman's controller on the platform. The current then passes from this speed controller to the motor or motors mounted on the car trucks and which are suitably geared to the car wheels. One side of the motor windings is grounded and the current then passes thru the axles and wheels to the rails on which the car runs, and thru which the current is returned to the negative side of the power station dynamo.

Of course, the rails must form a very good conductor, and any ordinary joints between rails will not do, and so these are made electrically perfect, or as nearly so as possible, by "bonding" them with copper cables, welded or riveted to each rail. Even then there is often considerable leakage of the current from trolley rails, and in cities this leakage current often works considerable evil by passing thru water and gas pipes, and when they leave such pipes as these, they carry with them in an electrolytic manner some of the metal composing the pipe.

THE DOUBLE WIRE-TWO POLE TROLLEY.

For the reasons just enumerated—that is due to electrolysis of many city water and gas pipes and also from the point of scenic effect, many cities have never allowed the trolley companies to install any overhead wires, or in some other cases they have prevented the trolley companies from holding franchises to permit the return current to pass thru the rails.

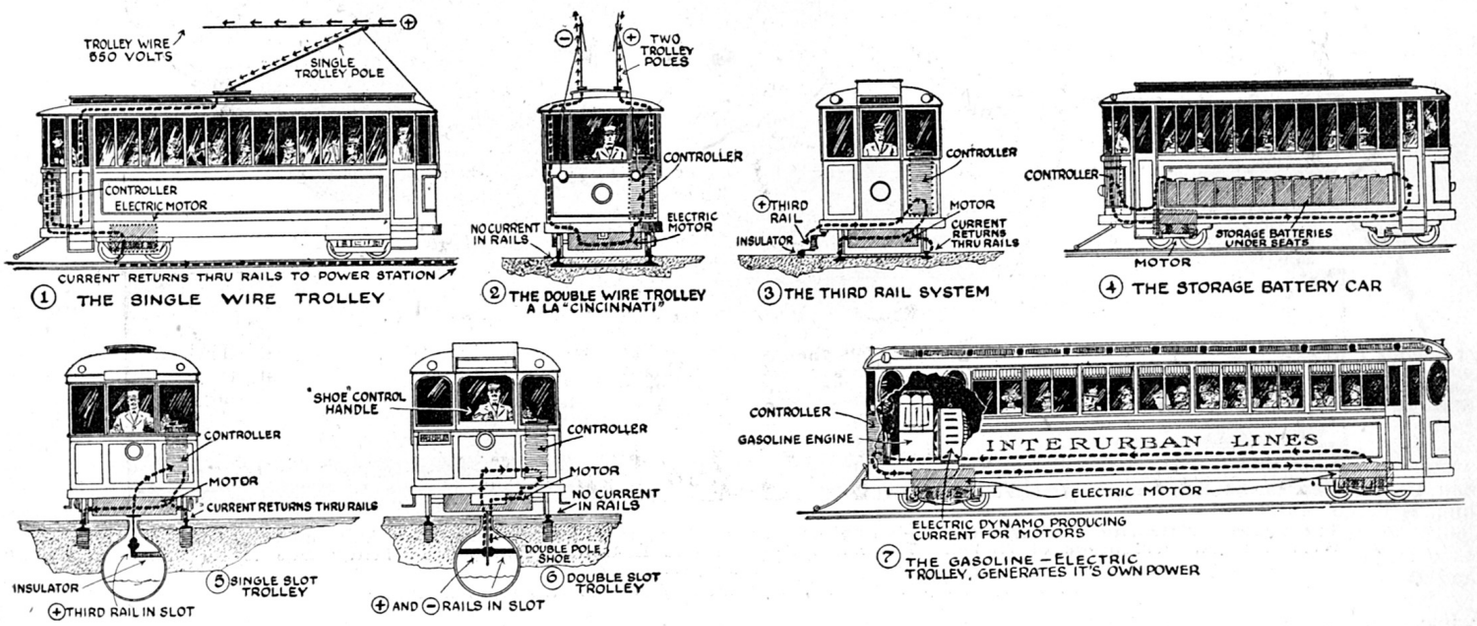
In Cincinnati they have one of the cutest little trolley systems you ever saw in your life! They do not return any current thru the rails, and a glance at Fig. 2 tells you the reason why! Every trolley car has *two poles* bearing against *two trolley wires*—these members being spaced about 18 inches apart. One wire is charged with positive current while the other is the negative wire, that is, the current comes from the power station dynamos along one wire, passes down thru one pole, thence to the controller and motor, from which point it is returned thru the second trolley pole to the negative trolley wire.

When one first sees this double trolley pole arrangement and until he has seen these cars negotiate curves and corner turns, he is almost willing to bet his last dollar that they cannot get around a corner very fast without having trouble, and lots of it! But such is not the case, and from what the writer recently saw of them, they turn corners faster than the slot system trolleys in New York and several other cities employing that method.

THE THIRD RAIL SYSTEM.

This method of supplying current to electric trolley cars and trains has been widely employed, and it is, of course, in its usual form not adapted to city use, as the third rail would be too dangerous even tho it were covered in some way.

In the third rail system, this member serves the same purpose as the trolley wire in Fig. 1 (See Fig. 3). The positive current passes along from the power house generators or sub-stations on the insulated third rail and the car takes current from this rail continuously by means of a specially flexible contact shoe. The current then enters the controller, whence it goes to the motor and then to the wheels and rails thru which it returns to the power station. There are systems in Europe which have been operated by means of two and three third rails with contact shoes bearing on each, so that no current has to pass thru the rails.



Among the Trolleys We Have Met in our Perambulations About the Country Are Those Illustrated Above. Out Cincinnati Way They Have the Double Pole Trolley With Two Trolley Wires Spread Along the Streets. In New York and Washington They Have the "Slot" System, Which Obviates the Use of a Third Rail or Trolley Pole—and Then There Is the Storage Battery Car and the Gasoline-Electric Car for Long Interurban Runs.

THE STORAGE BATTERY CAR.

At quite an early date in trolley history, there was proposed a storage battery car, to do away with the overhead poles and the ever-attendant troubles accruing therefrom, not to mention the marring of the beauty along the boulevards and prominent city thorofares. Many of these cars have been used from time to time, but not until recently was the storage battery car very successful owing to the fact that the fumes given off by the battery while working escaped thru the battery cabinets under the seats and into the passenger compartment of the car, and there is hardly anything more irritating to the throats and comfort of the passengers than the sulfuric acid battery fumes. However, in more recent years, and by suitable ventilation means as well as by improvements in battery design, this objection was practically overcome, and in New York City there have been operated lines of storage battery cars for a period of several years. These were the little red cars which ran along the "Belt Line" circuits, and those who are familiar with New York transportation lines will undoubtedly remember them. They were operated over some of the old horse-car belts, for the pur-

(*Continued on page* 1057)

Popular Astronomy

By ISABEL M. LEWIS, M.A.

Of the U. S. Naval Observatory

Meteorites

METEORITES are stones that fall to the earth from the heavens. They furnish the one tangible evidence that we possess, aside from that of the spectroscope, as to the composition of other bodies in space and it is a significant fact that no unknown elements have ever been found in meteorites, tho the compounds are so characteristic that they make these stones readily distinguishable from stones of terrestrial origin.

The origin of meteorites is not definitely known tho the evidence is very strong in favor of the theory that they are the larger fragments of disintegrated comets of which meteors, shooting stars, fire-balls and bolides are the smaller; the distinction between the two being simply that the latter class includes all bodies that are completely consumed by friction with the earth's atmosphere and, therefore, only reach the surface in the form of meteoric dust.

According to other theories meteorites may be fragments of shattered worlds that have chanced to come too near to a larger body and have been disrupted by tidal friction or they may be possibly the debris left after the major planets and their satellites were fashioned from the primitive solar nebula.

Interplanetary space is far from being a void. Our own planet sweeps up in the course of a single day, it has been estimated, approximately twenty million shooting stars or meteors of sufficient size to be visible to the naked eye while the estimate for the telescopic particles runs up to four hundred million.

Meteorites on the other hand are far less numerous. On the average it has been concluded, about one hundred meteorites strike the earth in the course of a year of which number only two or three are actually seen. According to Bulletin 94, U. S. National Museum, approximately six hundred and fifty falls and finds of meteorites have been reported, representatives of which appear in museums and private collections.

Meteorites, as well as shooting stars and meteors, frequently appear in showers. In such instances the fall usually consists of several hundred or thousand individual stones and the area over which they fall is several square miles in extent and roughly ellipsoidal in shape. One of the most remarkable of such falls occurred in January, 1868, when something like one hundred thousand stones varying in weight from fifteen pounds to a small fraction of an ounce fell near Pultusk, Poland. Another remarkable fall of meteorites occurred at L'Aigle, France, in 1803. Between two thousand and three thousand stones fell over an ellipsoidal area six and two-tenths miles in greatest diameter, the aggregate weight of the stones being not less than seventy-five pounds.

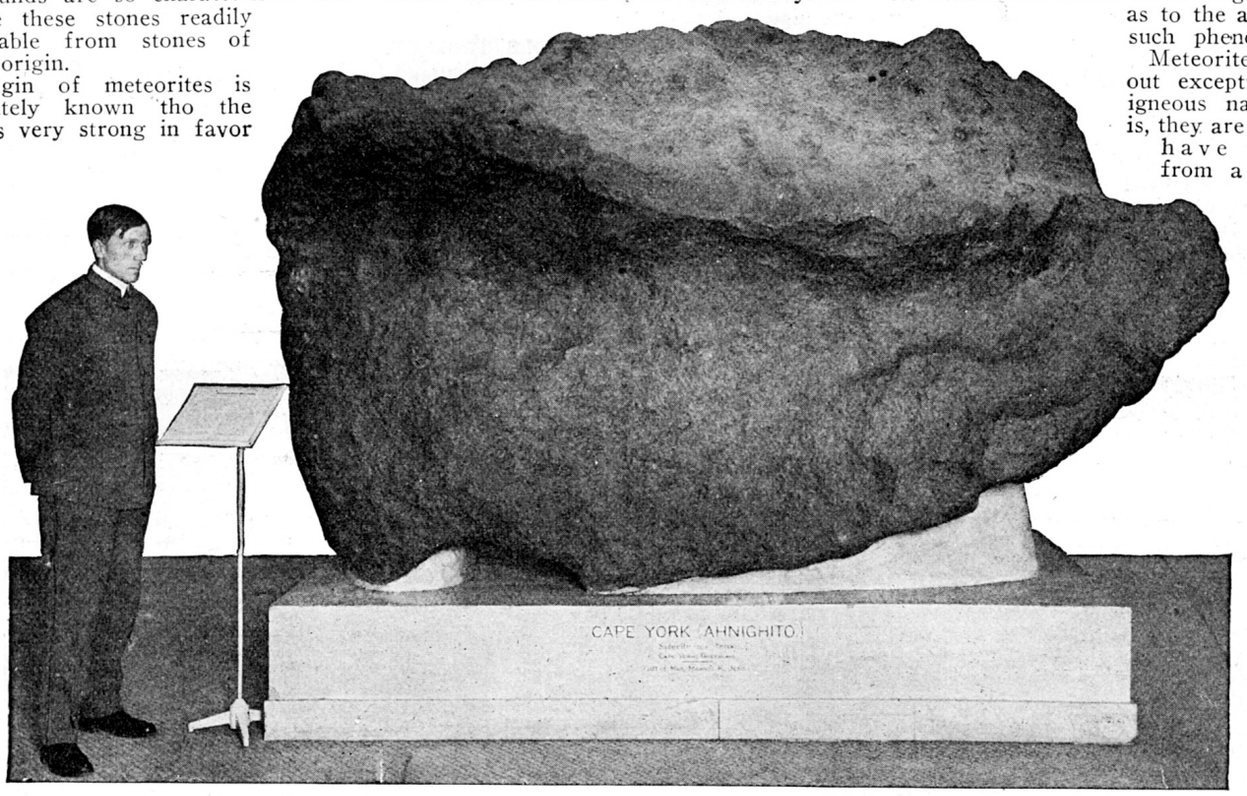
This fall of stones is of particular interest since it took place at a time when men were still very doubtful as to whether or not stones actually fell to earth from the heavens.

After this fall had occurred in a most populous district of France in broad daylight and attended by violent explosions that lasted for five or six minutes and were heard for a distance of seventy-five miles no reasonable doubt could longer be held as to the actuality of such phenomena.

Meteorites are without exception of an igneous nature, that is, they are rocks that have solidified from a molten condition. They can be classified into three groups, Aerolites or Stoney Meteorites, Siderolites or Stony-iron Meteorites, and Siderites or Iron Meteorites.

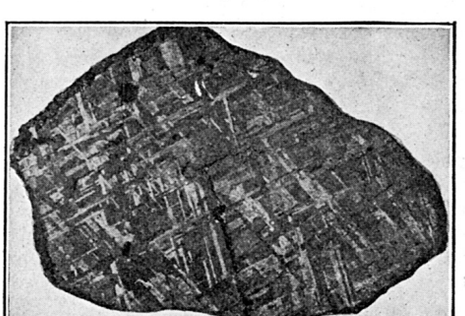
Strange to say, of all the meteorites that have been seen to fall only nine belong to the group of Siderites or Iron Meteorites tho the three largest meteorites known Peary's meteorite from Cape York, Greenland, weighing 37½ tons, the meteorite lying on the plain near Bacubirito, Mexico, weighing about 20 tons and the Willamette, Oregon meteorite weighing 15½ tons all belong to this group. Moreover, all the Canyon Diablo meteorites which are strewn concentrically around Coon Mountain crater in northern Arizona to a distance of about five miles are members of this same group. Coon Mountain or Meteor crater itself is a perfectly round hole about six hundred feet deep and over four thousand feet in diameter and was formed, it is believed, by the impact of a huge meteorite which has never been found. It is believed that the Canyon Diablo meteorites of which there are nearly four hundred individuals in the U. S. National Museum alone, were members of this same fall. It is possible that these meteorites of the Canyon Diablo district with the huge meteorite that produced the crater itself formed the nucleus of a comet that struck the earth not more than five thousand years ago according to the geological evidence.

All iron meteorites or siderites (from the Greek sideros, iron) are composed chiefly



The Largest Meteorite in Existence, Weighing 37½ Tons. Note Its Immense Size. The Material Is Chiefly Iron With a Small Percentage of Nickel. The name Ahnighito Is Eskimo, Meaning the "Tent," Due to Its Tent-Like Shape.

Photographs, courtesy American Museum of Natural History, New York.



Slice of Kingston Meteorite Showing Widmanstätten Figures. This Meteorite Fell In New Mexico. The Figures Are Obtained by Polishing and Then Etching the Metal by Means of a Weak Acid.

of alloys of nickel and iron. Two of these alloys occur in the form of thin plates and a third fills the space formed by the intersection of these plates. The percentage of nickel in these iron meteorites is very small, usually from five to ten per cent, while the iron forms about ninety or ninety-five per cent of the whole. Cobalt is also present in practically all iron meteorites in small quantities of 1 per cent or less. Usually small quantities of iron sulphide and phosphide as well as graphite or some other form of carbon appear in the iron meteorites and in some instances black and white diamonds have been found, as in some of the Canyon Diablo irons.

A very interesting and beautiful feature of many iron meteorites is the Widmanstätten figures which appear when a section of such a stone is polished and treated by means of a weak acid. These figures are due to the unequal solubility of the three different alloys of nickel and iron of which the stones are composed. (See photos.) The irons giving the Widmanstätten figures are known as octahedral irons. Other irons known as hexahedral irons give figures of a different type known as Neumann figures when the polished section is treated with weak acid while other irons are so homogeneous in their composition that they show no figures at all.

Aerolites or Stony Meteorites occur more abundantly than iron or stony-iron types and they are classified into many divisions and subdivisions according to their composition. In these stones appear certain compounds that are commonly met with in terrestrial igneous rocks. The mineral that is most abundant in the stony meteorites, composing sometimes nearly seventy-five per cent of the stone, is a magnesium and iron silicate known as olivine which is also usually present in terrestrial rocks of an igneous nature. Certain compounds found in the stony meteorites are rarely if ever found in terrestrial rocks, however, and these serve to distinguish the stony meteorites readily, from stones of terrestrial origin. The alloys of iron and nickel, for instance, that occur in minor quantities in the stony meteorites and make up usually about ninety-five per cent of the mass of the iron meteorites are not found in terrestrial rocks. Altho about thirty of the terrestrial elements are to be found in meteorites, the forms and compounds in which they appear are so characteristic and to a great extent so different from those occurring in terrestrial rocks, that the analyst has no difficulty in distinguishing between the two. There are, for instance, certain formations known as chondrules, peculiar spherical and oval shapes, varying in size from minute particles to objects the size of a walnut, appearing in many varieties of stony meteorites that are never found in terrestrial rocks, and that are one of the most interesting puzzles associated with the origin and nature of these stones. Sometimes the chondrules are so loosely embedded in the stone that they fall away when it is broken. In some instances almost the entire stone is made up of these chondrules. According to one theory the chondrules were originally molten drops, like fiery rain, and their internal structure which is greatly varied depends upon their conditions of cooling.

The Famous Willamette Meteorite from Willamette, Oregon. One of the Largest Meteorites in Existence. Note the Peculiar Pit Formations Large Enough to Seat the Two Boys. These Pits Were Probably Formed by Gases While the Meteorite Still Was in the Molten Form While Passing Through the Earth's Atmosphere.

Stony meteorites in which these chondrules are to be found are spoken of as chondrites. There are white and gray and black chondrites and crystalline and carbonaceous chondrites according to the nature of the chondrules found in the stones.

Stony meteorites also contain minute quantities of iron and nickel alloys in the form of drops or stringers.

Upon entering the earth's atmosphere stony meteorites become coated with a thin black crust which is a glass formed by the fusion of its surface materials by the heat generated during its passage thru the atmosphere.

In many of the stony meteorites there also appear fine thread-like veins which are due to the fracturing of the stone prior to its entrance into the atmosphere. The material filling these veins is coal black in color, opaque and of an unknown composition.

Many meteorites show signs of collisions and encounters with other meteorites outside of the atmosphere as would be expected as they travel in swarms and groups. Sometimes the entire meteorite is composed of fragments of two or more distinct stones cemented together. Such a stone is spoken of as a *breccia*.

In the third class of meteorites to which we now come, known as the stony-iron meteorites, there is a network or sponge of nickel-iron alloy the interstices of which are filled with stony material.

When this network or sponge is continuous the meteorite is spoken of as a stony-iron pallasite. When the network of metal is more or less disconnected the meteorite is a meso-siderite.

If meteorites are heated in a vacuum, the conditions existing in interplanetary space being thus produced to a certain extent, they give forth their occluded gases and it has been found that these gases give spectra identical with the spectra of certain comets. Meteoric irons give forth hydrogen as their characteristic gas while the gases occluded in the stony meteorites are chiefly the oxides of carbon, carbon monoxide and carbon dioxide. It has been found that the amount of gases contained in a large meteorite or shower of meteorites is sufficient to form the tail of a comet. These facts all tend to strengthen the belief that meteorites are indeed cometary fragments.

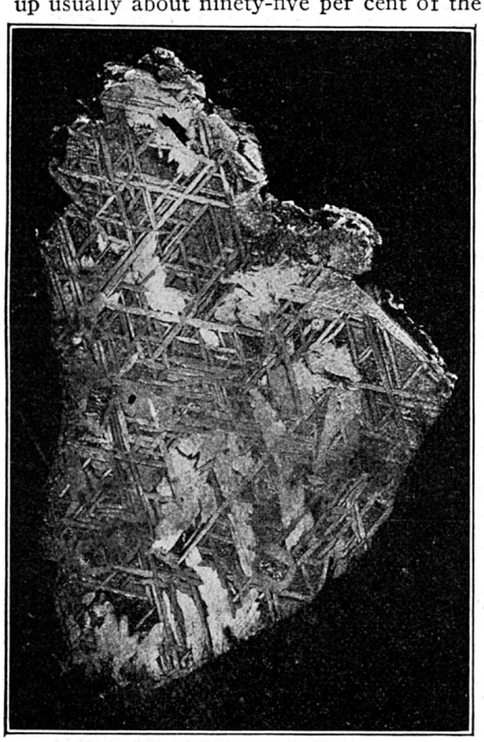
In view of the fact that some geologists believe meteorites may be fragments of other worlds it is of interest to know that so far no fossil-bearing meteorites have been found and if meteorites are fragments of a shattered world such worlds must have been reduced to a molten condition at the time of the catastrophe.

The rapid passage of the meteorite thru the air leaves a partial vacuum in its trail into which rush the molecules of air from all sides producing the characteristic noises that accompany the passage of a meteorite which have been compared to the rattle of artillery, the distant booming of cannons or the rumble of thunder.

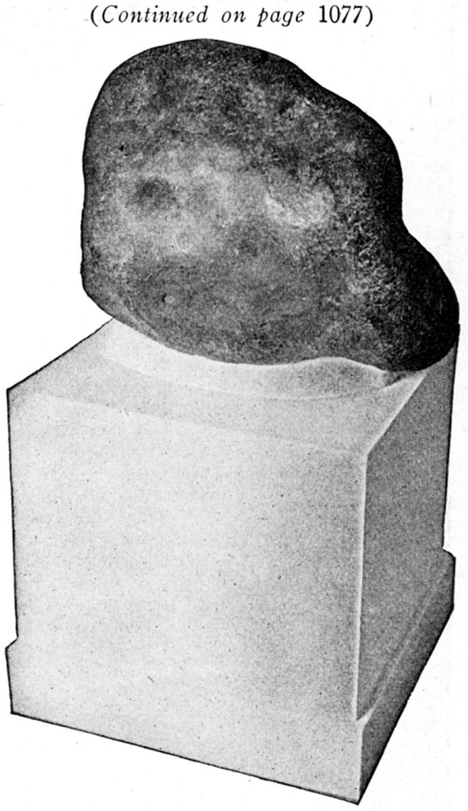
There may be, moreover, explosions of inflammable gases occluded in the crevices of the meteorite which will shatter it into fragments or the meteorite may be shattered by the resistance and pressure of the atmosphere or as a result of the extremes of temperature existing between the interior and its surface. Many meteorites have actually been seen to burst into fragments in the air with a loud report.

There is practically no foundation for the belief that germs of life have been brought to our planet on such igneous rocks. No

(*Continued on page* 1077)



Section of Knowles Meteorite Showing Widmanstätten Figures. These Lines Are Characteristic in All Meteorites.



This Is the Famous "The Dog" Meteorite from Cape York, Greenland. It Weighs Several Hundred Pounds.

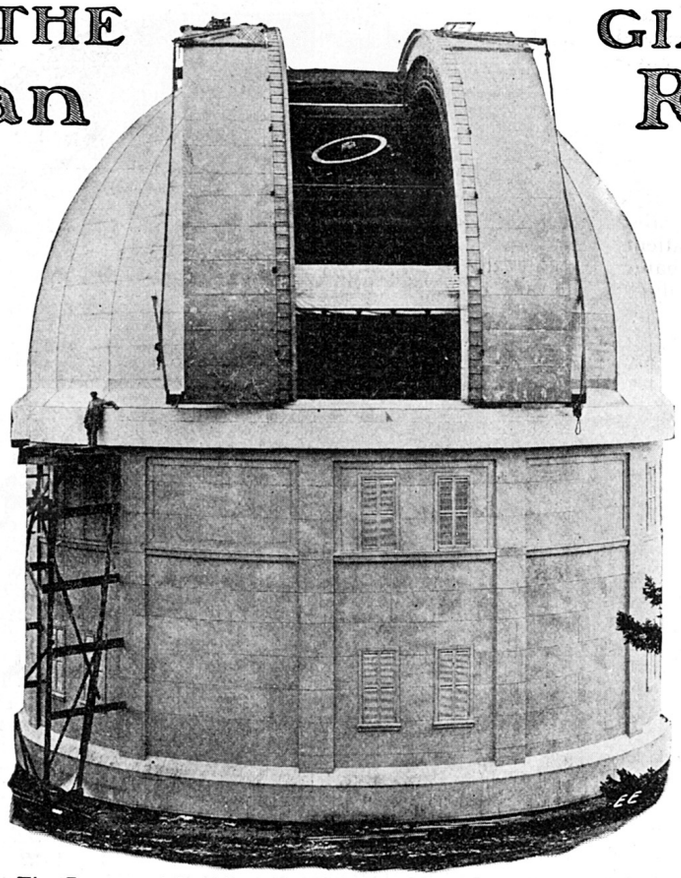
THE Canadian GIANT Reflector

By Professor Floyd L. Darrow

THE 73 INCH CANADIAN TELESCOPE

SECOND PAPER ON BIG TELESCOPES

A DECADE ago the world celebrated the three-hundredth anniversary of the invention of the "telescope," and in fitting recognition of the tremendous service to science of these marvelous adaptations of lenses and mirrors there were under construction at that time the two largest telescopes ever projected. The 100-inch reflector at Mount Wilson, California, was described in the January issue, and in the present article we shall consider the big Canadian telescope which for a brief period enjoyed the distinction of being without a peer among the observatories of the earth and is still of very great scientific interest.



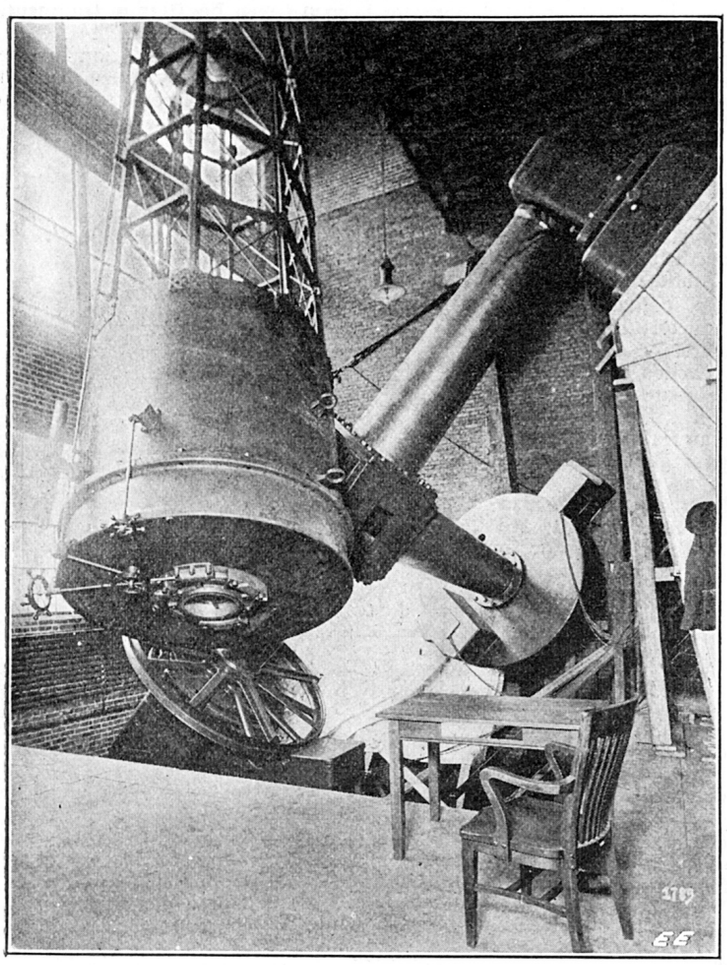
The Dome and Building Housing the Giant Canadian Reflector, Photographed from the North. Diameter 66 Feet, Height 75 Feet. The Dome "Shutters" Open Up to a Width of 15 Feet, Exending Past the Zenith. The Upper End of Telescope Tube with the Observing Platform in Position Are Seen Half Way Up the Shutter Opening. Note Size of Man on Scaffold.

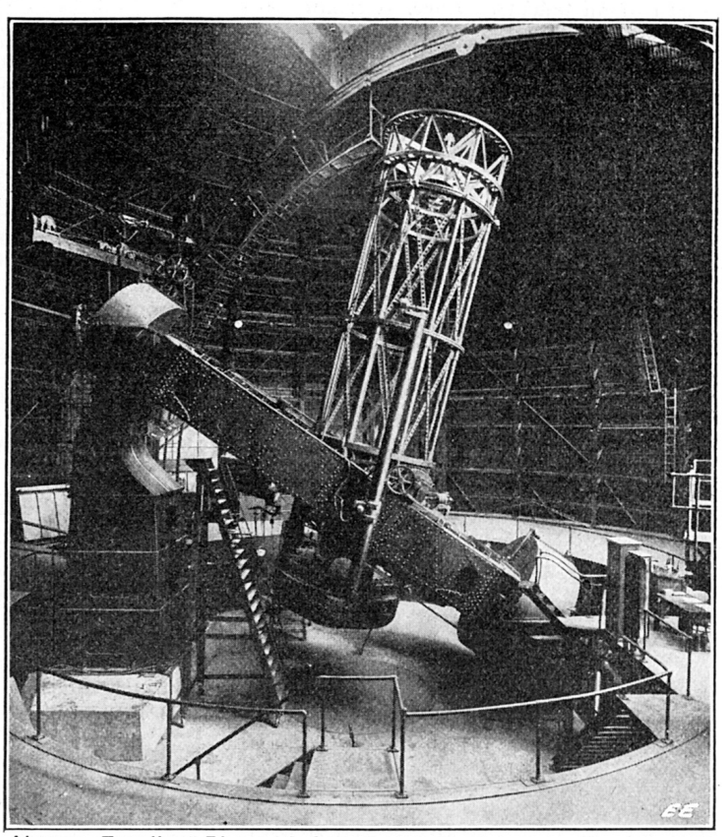
Crowning the summit of Saanich Hill, Victoria, B. C., stands the Canadian observatory at an elevation of 732 feet. There the "seeing" qualities of the air were found to be much better than in Ottawa, and this is the fundamental factor in determining an observatory site. The exacting requirements of science and not those of politics or local pride must be the sole consideration in a work of this kind. Fifty acres of land were purchased around the summit of the hill and an electric railroad built to the top.

The mirror was cast at the famous works of St. Gobain, France, now in ruins from German occupation. It was placed on ship-board for transportation to Canada just two days before the beginning of the Great War, and it is good to know that in the midst of this great world cataclysm, so noble a work of science could proceed unmolested. Its purposes are as eternal as the universe and as far removed from world strife as the stars are high above it.

It is true that the mirror of the famous Rosse telescope had an aperture equal to that of the big Canadian reflector, but it was of *speculum metal* instead of glass and far from perfect. The art of grinding and figuring mirrors has made marvelous progress in the last three-quarters of a century. The mounting, too, of the big English telescope did not permit of its convenient use for astronomical observations. Previous to the building of the Canadian telescope, the 60-inch reflector at Mount Wilson was the largest practical instrument ever constructed, but this has now been twice out-distanced and what the future holds in store no man can foretell.

The mirror, the fundamental element of the giant telescope, is 73 inches in diameter, 12 inches thick at the edge, and is pierced by a hole at the center 10⅛ inches in diameter as shown in an accompanying view. Its weight is 4,340 pounds. The back is flat and the front concave, being very slightly parabolic in form. The con-





Above:—Excellent Photo of the Mt. Wilson Telescope Described in the Last Issue of the Electrical Experimenter. Note the Different Style of Mounting as Compared to the Canadian Reflector Here Described and Illustrated.

At Left:—View of Large Canadian Reflector, Showing Mirror Cell and Lower End of Tube. A Wonderful Electric Controlling System Enables the Astronomer to Train This Telescope on Any Heavenly Body and Follow It Accurately.

cave surface differs from a true sphere by only one one-thousandth of an inch and nowhere deviates from the theoretical curve calculated by the mathematicians by more than the *two-hundred-thousandth of an inch!* The grinding of such a mirror is one of the most exacting and delicate tasks of the optician's art. Anything less than the most skillful craftsmanship will ruin the glass and bring to naught long years of patient labor. No other product of the mechanical arts speaks so eloquently of the infinitude of human toil and painstaking care as a finished lens or mirror. There is not a moment from the mixing of the batch materials for the casting of the glass down to its successful mounting in the telescope tube, that it is not the object of anxious solicitude.

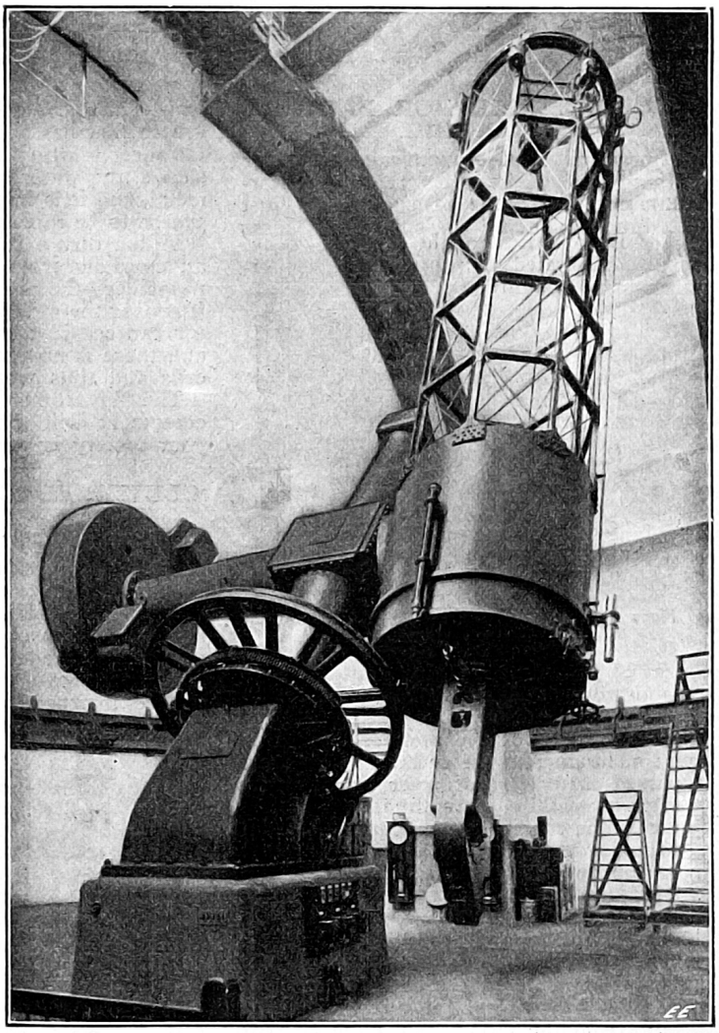
Second only in importance to the mirror itself are the mounting and housing of the telescope. The telescope tube is 31 feet long, 7½ feet in diameter and weighs 12 tons. It consists of three sections, the lowermost one being the mirror cell, in which the massive glass is held so securely that no flexure or distortion can occur. Above this is a central cylindrical casting 6 feet long and weighing 7 tons, to the upper end of which is firmly attached the rigid skeleton tube. This skeleton is 23 feet long and weighs 2 tons.

The telescope tube is mounted on two axes at right angles to each other. The *polar axis* is parallel with the earth's axis and therefore points constantly to the pole star. It is 23 feet long and weighs 10 tons. The other axis, called the *declination axis,* is 14½ feet long and weighs 5 tons. At its right hand end it carries a flange 41 inches in diameter, to which the telescope tube is attached. At the opposite end of the *declination axis* a heavy counterpoise keeps the weight of the axis in perfect balance. So nicely is this huge mass, representing a total weight of 55 tons, poised on the ball bearings of the polar axis that *a pressure of 5 pounds will set the tube in motion.* The two axes can be clearly seen in an accompanying photograph. The circular housing at the left contains the motors and gearing for rotating the telescope on either axis.

The housing at the foot of the polar axis contains the driving clock with the gearing of which the toothed wheel, 9 feet in diameter and weighing 2 tons, meshes. The driving weight of the clock is a falling mass of 1,000 pounds. This clock is so made that it will turn the polar axis and with it the telescope around once in exactly 24 hours. The necessity for this will become apparent from a consideration of the fact that a star does not stand still in the heavens but appears to move from east to west just as the sun does. Thus if the telescope were trained on a star, the latter would remain centered for only a few moments and would quickly pass out of the field of vision if there were not some provision for counteracting its apparent motion. The motion is due, of course, like the sun's rising and setting, to the rotation of the earth on its axis. Therefore, by turning the telescope about its polar axis at the exact rate of the earth's rotation, but in the opposite direction, a star once centered will remain so until it disappears from view below the horizon.

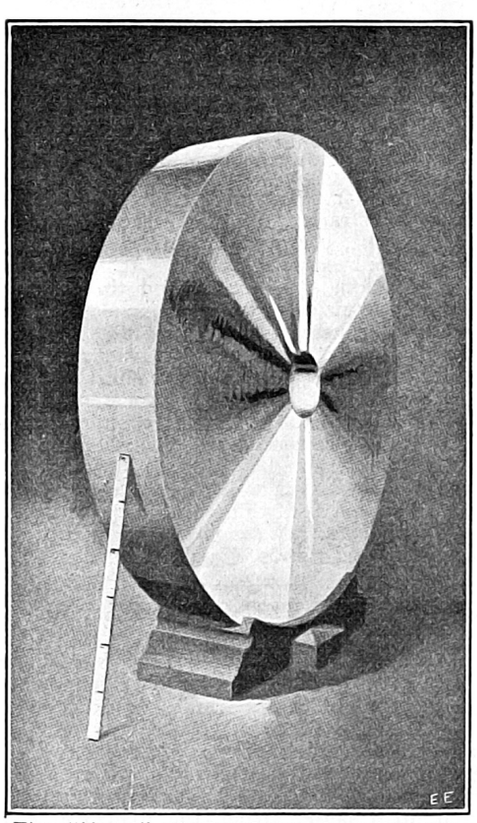
Aside from the driving motion of the clock the telescope may be subjected to three other motions. These are accomplished by means of 7 electric motors with solenoids and magnetic clutches. The first is a rapid movement for the approximate training of the telescope on any star. This motion is at the rate of 45 degrees per minute and it may be about either axis. The two slower motions are for "fine setting." There are two electric switchboards for controlling these motors, one on each side of the observatory, and in addition a portable switch-board from which the operator may set the telescope, rotate the dome and elevate or lower the floor without leaving his chair. When a star has been found the driving mechanism is thrown into gear and the star seems to stand still in the field of vision.

The polar axis is mounted on massive piers of reinforced concrete and the whole is housed in a steel structure 66 feet in diameter. Double walls of sheet metal surround the sides and these are surmounted by a dome weighing 120 tons. The dome is provided with a shutter 15 feet wide, which is opened when observations are being made. An electric motor turns the dome completely round in 6 minutes, thus enabling the operator quickly to turn the opening to any point of the compass. The observing bridge, controlled by electric motors, may be brought into any desired position.



Another Remarkable View of the 72-Inch Reflecting Telescope of the Victoria Observatory, Canada, the Second Largest in the World. Its Mammoth Glass Mirror Measures 73 Inches in Diameter, 12 Inches Thick at the Edge (See Cut of Mirror Below), and Weighs 4,340 Pounds. The Telescope is 31 Feet Long, 7½ Feet in Diameter, and Weighs 12 Tons.

The silvered surface of the mirror brings the light of distant stars and planets to focus 30 feet above its surface. For use as a *Newtonian* type telescope a plane mirror 19 inches in diameter and inclined at an angle of 45 degrees is placed at this point, and the light is reflected to the eyepiece, photographic plate or spectrograph at the side of the tube. An electrically operated elevating platform permits observations at the top of the tube. For very faint stars the photographic plate or spectrograph can be placed at the prime focus itself.



The "Heart" of the Great Canadian Reflector—the 73-Inch Reflecting Mirror. Thru the Center of the Mirror is a Hole 10⅛ Inches in Diameter.

More frequently, however, the telescope will be used in the *Cassegrain* form. For this combination a 19-inch convex mirror is mounted 7 feet from the upper end of the tube and reflects the light back thru the hole in the center of the large mirror to the eyepiece, photographic plate or spectrograph. Used in this way the equivalent focal length becomes 108 feet.

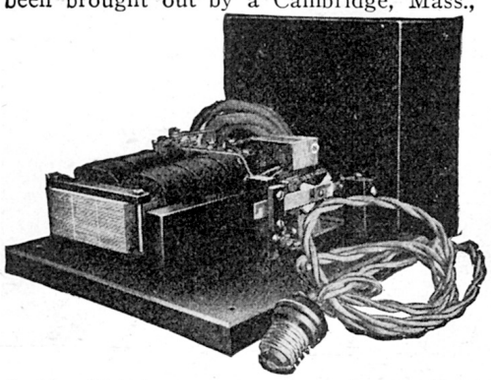
The principal work for which this telescope has been designed is to analyze the light of the stars by means of the *spectrograph.* A spectrograph is an instrument for dispersing light into its component colors and photographing the spectra thus produced. These spectra not only tell us what elements are present in the star's atmosphere but also reveal the motion of the star. When a star is approaching our solar system its spectrum is shifted toward the violet, and when receding the displacement is toward the red. By the amount of this shifting the star's velocity may be determined within two or three miles per second. The spectrograph also reveals the physical state of stars, nebulæ and comets. A continuous spectrum means an incandescent solid or a gas under great pressure, while a discontinuous or bright-line spectrum proves the presence of a light, vaporous firemist.

(*Continued on page* 1054)

. . . Automobile News . . .

NEW RECTIFIER FOR BATTERY CHARGING.

A practical and economical device for charging storage batteries from an alternating current source of supply has just been brought out by a Cambridge, Mass.,



A New Battery-Charging Rectifier Which Cannot Charge Backwards.

concern. It is intended for home, garage or laboratory use where it is not desired to charge a large number of cells at one time.

The operation of the rectifier is as follows: The current on entering the device is passed thru a transformer to lower its voltage to slightly more than that of the battery. The current is then conducted thru a vibrating reed which oscillates to and fro in unison with the changes in direction of the alternating current. On the end of this reed is a contact point which makes contact with another similar point connected to the storage battery whenever the current is flowing in the correct direction to charge the battery. It disconnects the battery from the circuit when the current is flowing in the wrong direction.

The impulses thus flow into the battery in one direction only. The maker states that the instrument is so constructed that it automatically charges in the right direction regardless of which direction the battery is connected. The advantage claimed for this device is its simplicity, there being no lamps, liquids, rheostats or other parts liable to become broken, or to require frequent renewal. The instrument is supplied with a cord and plug for connection to any 60-cycle lighting circuit. The battery may be charged overnight if desired, and the battery need not be removed from the car or other place of mounting. The rectifier is self-starting and in the event of temporary failure of the supply current, the battery is automatically cut off so that it cannot discharge back through the rectifier. Upon the restoration of service it automatically starts charging again.

UNIQUE DISTILLED WATER BOTTLE AND STORAGE BATTERY FILLER.

This device is made of glass, holds a half-gallon of water, has a dial on top to show last date battery was filled, while thru the fiber cap, and down into the bottle, is a Hydrometer Syringe, which is used for transferring the water from bottle to storage battery cells, and testing the strength of the solution.

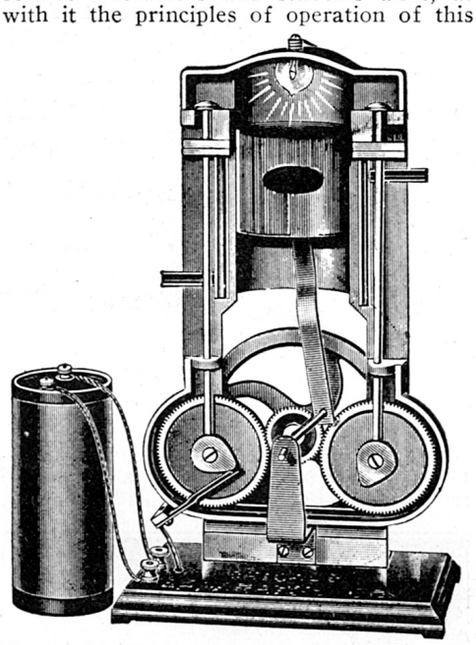
The old method of filling storage cells with distilled water by pouring the water thru a funnel, subjects the water to contamination from two sources: First—Thru contact with a metal funnel; and Second—Thru contact with dirt, dust and grease that has accumulated in the funnel. However, with the arrangement here shown, the water comes in contact with no metal, and it is impossible for dirt, dust or grease to be injected into the cells.

Filling thru a funnel is also apt to cause an overflow from the cells, but with this new filler—the point of the syringe resting just over the mouth of the cells—the operator can see just exactly what he is doing, and there is no chance of over-flowing the cells and thus weakening the battery.

The Hydrometer furnished with this equipment will show at a glance whether your battery is partially or fully charged.

CLEVER ELECTRIC GAS ENGINE MODEL.

No gas engine is more extensively employed at the present time than the vertical four-cycle type. It is the heart of the automobile, motor truck, airplane and motor boat. In view of these facts the electric gas engine model designed by a Chicago firm will prove exceptionally valuable to science instructors and students alike, as with it the principles of operation of this



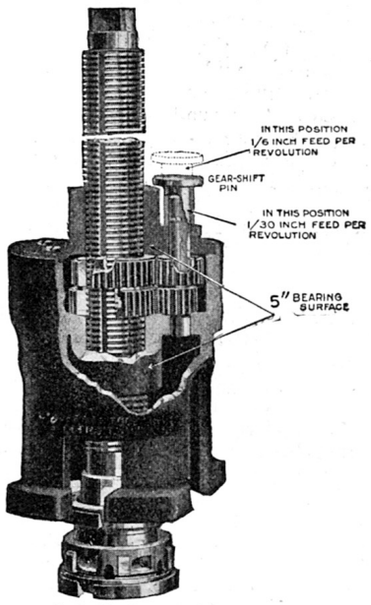
The Light Flashes Like the Spark Plug In This Engine Model.

most popular type can be clearly and effectively illustrated. It clearly shows the intake stroke, compression stroke, explosion stroke and exhaust stroke. It illustrates valve action, cam action, and timing-gear action. It also shows the principles of the ignition system. It demonstrates clearly the following parts in their true relationship: Cylinder, piston, crank shaft, valves, gas intake port, exhaust port, water jacket, water inlet, water outlet, timing gears, valve-lifting cams and fly-wheel. The spark plug is represented by a small incandescent bulb *which flashes at the beginning of each explosion stroke*, thus producing a most realistic effect. The model is made entirely of metal and stands 15 inches high.

AN IMPROVED CYLINDER REBORER.

The new cylinder reboring tool, here illustrated, enables anyone to rebore cylinders in their own garages, or it can be used on the farm to rebore cylinders of any tractor, truck or passenger car.

About 10 to 18 minutes is all the time required to rebore a cylinder with this tool, and do a better, truer job than you can possibly do by lapping in by hand. Lapping in pistons takes from 2½ to 3 hours per cylinder and the result is not a first-class mechanical job in any case.



Improved Cylinder Reborer for Autoists.

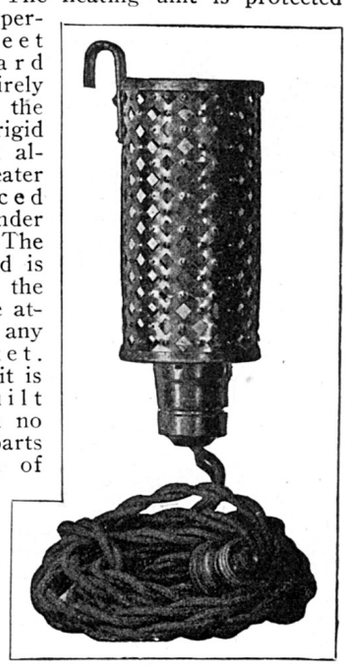
With a universal cylinder reboring tool any ordinary mechanic in your shop can rebore the cylinders of any motor, either detachable head or closed end cylinders, and do a perfect job—make a correct fit on every cylinder, regardless of the oversize of piston to be used. One operation for each cylinder is all that is necessary.

You can take out 31 one-thousandths of an inch or 1 one-thousandth of an inch in one cut. Any workman can operate it.

ELECTRIC HEATER FOR AUTO ENGINE.

This heater fills a need long felt by nearly every automobile owner for a simple, economical and effective method of keeping his automobile engine and carburetor warm during the frosty days of winter. It is the ideal method of keeping the engine warm while the car stands in the garage. Thus, on cold mornings no difficulty will be experienced when starting the engine, as the temperature of the engine will always be well above that of the outside air.

It is ruggedly built and practically indestructible. The heating unit is protected by a strong perforated sheet metal guard wound entirely around the heater. A rigid metal hook allows the heater to be placed anywhere under the hood. The flexible cord is long and the plug can be attached to any lamp socket. Altogether it is a well-built heater with no delicate parts to get out of order. The heater is placed where it it will do the most good at least cost.



Perpetual Motion Contest Awards

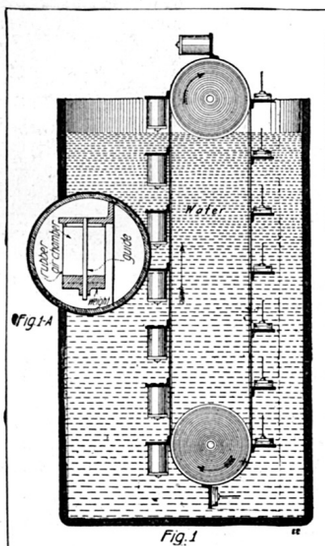
THE "Perpetual Motion" Prize Contest, which was publisht in the November issue, was a howling success, and we received enough letters to keep the Board of Judges busy for several long evenings. All the answers to the perpetual motion contest, were examined by the following Board of Judges: Professor John J. Furia, Instructor of Physics, New York University; H. Gernsback, Editor of ELECTRICAL EXPERIMENTER and RADIO AMATEUR NEWS; and H. W. Secor, Associate Editor of the ELECTRICAL EXPERIMENTER.

Up to the time of the closing of the contest, January 15th, the editors had received 2,596 letters attempting to explain why the three perpetual motion schemes here illustrated, and described in full detail in the November issue, would or would not work.

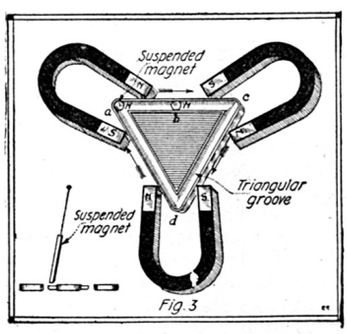
We have been so favorably imprest by the first two letters here publisht, those from Messrs. Ralph A. Wood and B. O. Burgin, that we have decided to pay each of them a $10.00 CASH PRIZE, instead of awarding but one $10.00 prize.

Mr. Burgin carries off the honors for the best technical answer as to why the three suggested perpetual motion schemes would not work, while the palm for the most humorous and technically correct solution goes to Mr. Ralph Wood. And we were certainly pleased to hear from the girls! Forty-four of the 2,596 answers received were from the "fair sex." The best solution received from the ladies was submitted by Hannah Dvorcef, of Montpelier, Vt. Her explanation of the perpetual motion schemes is publisht herewith. The judges have furthermore decided to give this contestant, as well as Mr. R. Hope, aged thirteen, who submitted the best solution for contestants, fifteen years or under, one year's subscription to the ELECTRICAL EXPERIMENTER. To Mr. Loy Coak of Jackson, Mich., whose answer is reprinted verbatim, a consolation prize of one genuine United States Steel engraving of Washington (a 1-cent stamp) has been awarded!

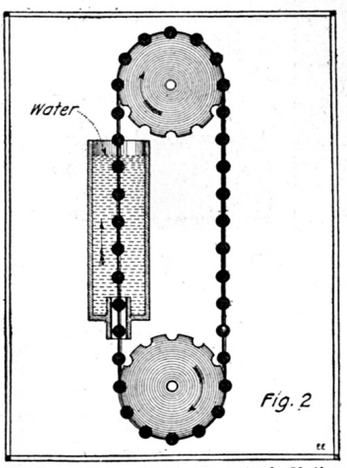
Several other very good solutions to the perpetual motion contest problems are publisht herewith, also. At an early date, we may have the pleasure of announcing another contest along similar lines, and we take this occasion to thank heartily all those who took an interest in this contest, and wish them better luck next time!



The Expansive Rubber Chambers Have Weights Fitted to Them, Which Weights Cause These Chambers to Collapse as They Descend Down Through the Water on One Side of the Belt; While as They Start to Ascend on the Up Side of the Belt, the Chambers Open up and Present a Considerable Amount of Buoyancy. Imagine What a Tremendous Amount of Buoyancy a Series of These Air Chambers Will Give!



A Magnetic Pendulum Arranged in the Manner Shown, so That a Suspended Magnet Reacts in a Field Created by Three Horseshoe Magnets. The Lower End of the Suspended Magnet Runs in a Triangular Groove as Shown. Apparently, the Pendulum Magnet Should Keep on Rotating Around the Groove, and in the Direction of the Arrows Perpetually! Is It So?



Another Water Power Perpetual Motion Idea Which Is Out of the Ordinary Class. This Promising Design of "Everlasting Motion" Machine Utilizes a Series of Hollow Balls Mounted on a Continuous Belt. Gravity Helps the Downward Motion of the Balls on the Right Side, While as Soon as They Enter the Water Chamber at the Left There Is Realized a Considerable Amount of Buoyancy Created by the Long Series of Hollow Balls Which Are Pushed Upward by the Water.

PRIZE WINNER $10.00.

Wal, wal, wal! What wont ye city fellers git up next? So ye've bin an invented perp-e-tual motion?

Now that there dingus in figger 1, she looks slick, gosh a'mighty, if she'd do what ye say I'd hitch one t'the old saw-mill an I'd have all my cord wood sawed up in no time. But say Gents, she sorter reminds me o' one a them there gold-bricks. Looks durn purty on th'outside, but cut her open an she's bogus inside. Jest ye take a nother slant at that wha'cha-call-it. How in thunder be them buckets a goin t'close up? I cant see no air vent t'let the air out when she gits t'the top, an if ye do have a air vent, an all th'air is squoze out when she tips over and goes down, how t'blazes be ye goin' t'git 'em filled up again down t'the bottom, 'cept with water, then whar's this here "buoyancy" gone to.

'S no use Gents I aint goin t'buy one 'till ye git her fixt bettern that.

There, Gents, ye take that there riggin No. 2 an she's a good-un, if she'll work. I'd have one o'them put in t'run the cream separator with but fur one thing. I'm afeered I'd do more work pumpin water t'keep that there stand pipe full, than I'd have to t'jest turn the old separator by hand as we'uns allus did. Why by Heck, Gents, ye see she'd be jest sure t'back fire an run tuther way till all the duned H_2O in that there tank run out, an then I'd have t'pump her up agin, every time she run out. So I guess I'll jest let that there new-fangled-she-bang alone, she'd make me work too hard.

What's that there contraption ye got the "Fig. 3" marked on, Gents? She looks like the old "YD" "Yankee Division" brand, but say, Gents, that rig aint no bettern yur other two.

Ye know Gents, when that there swingin "N" pole gits snuggled up t'that there "S" pole on one o'them there magnets, she'll git so affectionate and stuck on that there "S" pole, she jest wont do no wanderin on. It'll be a case o'love at first sight or mootual-attraction, an if any o'them other "N" poles has anything t'say, it'll jest be t'push her up tighter t'the old "S" pole. Then ye'll have to come along and shove her off, an t'keep her on the go I'm afeered ye'll find it too much work fur the price.

'S no use Gents, I'm real superstitious bout this here perp-e-tual motion. I've allus had th'idea 'at that there ain't no such animal, so I'm some sure it'll take more'n some purty pictures t'change them ideas.

When ye see a feller tryin t'lift himself by his boot-straps, try him, Gents, per'aps ye'll be able t'sell him one o'them there jiggers.

I am, Gents,

Your 's'pectfully,

RALPH A. WOOD,

97 Bartlett Ave., Arlington, Mass.

PRIZE $10.00.

The devices described on page 649 of the November number of ELECTRICAL EXPERIMENTER will not work as perpetual motion machines for the following reasons:

Scheme 1. Since the pockets are air tight, no air can enter or leave them. If the pockets are empty, as on the right, they will still be empty on the left, even though the weights are not supported by the brackets, because no air can enter. If, on the other hand, they possess air, as on the left, they will still possess the same air on the right, even though the weight is on the top, because the air cannot get out. In either case the buoyant effect will be the same on each side. Any compression of the air due to water pressure would be the same on both sides and, therefore, would not modify the action.

Scheme 2. The fallacy of this scheme lies in the fact that there will always be a ball entering the tube at the bottom of the tank which has a downward pressure on it due to the entire depth of water but no upward pressure because no water is under it. It is easily shown by principles of hydrostatics that no matter how many balls are used or how high the tank may be the downward pressure on the ball just entering would be greater than the buoyancy on all the others.

Scheme 3. The difficulty with this scheme is that it is assumed that the north pole of the suspended magnet will, during parts of its motion, move away from a south and toward a north pole. Suppose, for example, it were moving past "b" toward the right-hand magnet. Even tho its momentum carried it past S of the right-hand magnet (which is improbable) it would have to stop at "c" and would then move back toward S rather than toward N which repels it.

Very sincerely yours,

B. O. BURGIN,

Instructor of Physics, Albany High School, Albany, N. Y.

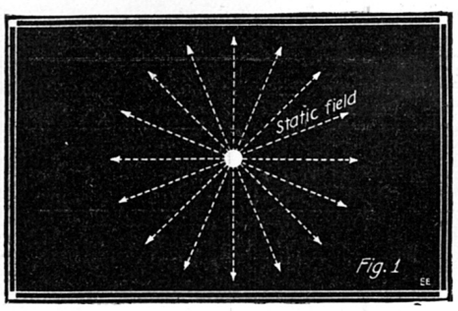
The other answers received to the Perpetual Motion Contest Problems printed in the continuation are equally interesting.

(*Continued on page* 1059)

The New Theory of Electrical Mass

By ROGERS D. RUSK, M.A.

THE idea that the mass or weight of a body is due to electricity and nothing else is rather surprising at first and yet this new theory is one that is quite steadily gaining ground. Electricity explains many things because it

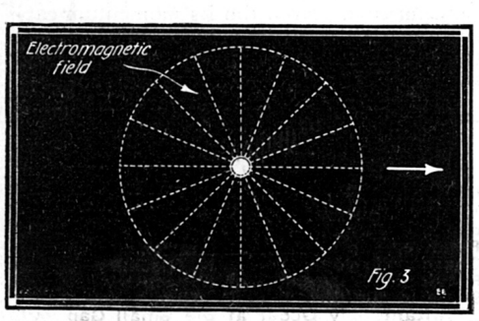


An Electron At Rest Has Only a Static Field and Its Weight Is Very Minute.

is one of the most fundamental quantities in the universe, and if matter is electrical in nature, as there now seems to be no doubt, then the properties of matter must in some way be electrical phenomena. This may seem to be a startling conclusion, and yet it is no more startling than the experiments by which it has been suggested.

When the notion of electrical mass or weight was first proposed a few years ago it was a very hazy and abstract notion. Today it has not only become more precise and practical, but it is of such far-reaching importance that it underlies all science and forms the basis for a complete electrical theory of matter. At the very start let us remember that the two words *mass* and *weight* have very much the same meaning except that the mass of a body or the quantity of matter in a body is always constant while the exact weight of a body may be slightly different at different points on the earth's surface where the attraction of gravity does not have the same value. For this reason we shall use the word *mass* to indicate that property of a body which causes it to have weight or to resist motion. The idea that mass is electrical in nature is a heavy blow struck at old-fashioned science which thought matter, electricity and energy and many other things were all separate and distinct quantities instead of being fundamentally interrelated, if not one and the same.

When it was discovered that all atoms of matter contain electrons, which are nothing more than minute electrical charges, scientists immediately began to wonder where atoms get their mass, and *if a particle of electricity could have mass.*



The Field About a Slowly Moving Charge or One at Rest Is Symmetrical.

In answering this question there are three possible theories; first, that the weight is totally electrical; second, that it is partly due to electricity and partly due to some non-electrical material which we will indicate by the word mechanical; third, that it is totally mechanical. The latter view is not tenable now because we know the electrical charges in an atom exert some effect on the mass so that the choice narrows down to the first two theories.

WHY ELECTRICITY RESISTS MOTION.

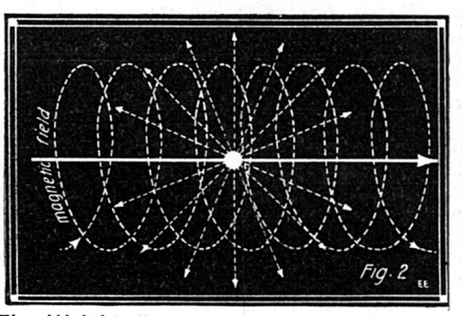
The first thing to consider is the way in which these electrons in an atom influence the mass of the atom, and it is easily explained. *The mass of a body is its power to resist motion.* Now a unit electric charge or electron also has the power to resist motion hence it has a certain amount of mass. Just why an electric charge resists motion is of fundamental importance. When at rest an electric charge has only an electric field as shown in Fig. 1. When the charge is in motion it has not only an electrical field as shown, but also a magnetic field as in Fig. 2. This field represents a certain amount of energy and the energy taken to set the charge in motion was the energy taken to create the magnetic field. In other words, in order to overcome the resistance of the charge to being set in motion, a certain amount of energy had to be used up in creating the magnetic field. This quantity is a measure of the electrical mass of the charge. Such a resistance with ordinary charges at ordinary speeds is a very small quantity and does not explain the notion that all mass is electrical.

It was at this time that J. J. Thomson, the electron wizard, suggested from mathematical considerations that in the case of very high velocities, approaching the velocity of light, the charge having the greater velocity would have the greater mass. This was a startling suggestion that the mass of an electrical charge would depend on how fast it was moving, but shortly it was able to be proved by experiment. It was a fortunate thing that radium had just been found to emit electrons at high speeds, and Thomson, Kaufmann and others experimenting with these high speed electrons found out that it was true that the faster-moving particles had the greater masses. As these electrons contained no mechanical matter at all, *it was evident that their mass was all electrical.* Hence it is plain that as all atoms contain electrons that part of the mass of the atom is electrical. The next question is: What is the rest of the mass of the atom due to?

According to the modern electrical theory of matter, *all atoms are composed of NEGATIVE electrons and POSITIVE particles and nothing more.* The electrons are unit charges of electricity only, but the exact nature of the positive particle has never been discovered so that there are two views concerning it which may be held. First, it seems logical to suspect that it may be similar to the negative particle and consist of nothing more than electricity. On the other hand, we cannot prove it yet, and it may have some mechanical matter in addition to its electrical charge. If the first is true then all the mass of an atom is due to electricity, but if the latter is true then part of the mass is due to something else which we may call mechanical matter and concerning which we know absolutely nothing.

HOW SPEED AFFECTS MASS.

At present experiments point strongly to the probability that all mass is electrical, and that the positive particle is similar in that respect to the negative particle, being different from it only in sign. That the



The Weight (Inertia) of a Moving Electron Is Greater Than One at Rest Because of the Magnetic Field Generated by the Motion.

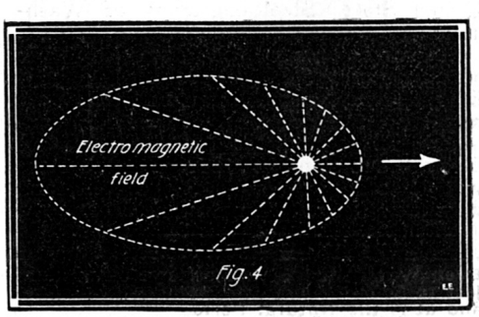
whole mass may be electrical will be more evident from the following explanation as to how an electric charge may have a very appreciable mass at high speeds when it has a very inappreciable mass at low speeds. This is the reason:

If we first consider a small metal sphere which is uncharged, then we say it has no field and there are no lines of force about. But suppose that all at once the sphere receives a charge, then an electric field is set up about the ball. This electric field is not established instantaneously but grows, so to speak, out from the charged sphere at approximately the speed of light. When the sphere is set in moderate motion, the sphere keeps its field in front of it as well as behind, but when it moves at high speeds, approaching that of light, it is not able to build its field in front of it before it has past on to another point, so that the field is distorted and drags out behind. As the resistance to motion of an electric charge depends on its field, the more the field is enlarged by distortion the more mass the charge will have. It is evident, however, that this only occurs at high speeds, and it is very easily understood by reference to the diagrams.

PICTURING ELECTRICAL MASS.

Fig. 3 shows a stationary or slowly moving charge with the usual symmetrical field. Fig. 4 shows a charge moving at a very high speed in the direction of the arrow and the distortion of the field that is produced. The charge could not build its field in front of it fast enough, and the field behind lags and is distorted because it does not disappear instantaneously after the charge has

(*Continued on page* 1079)



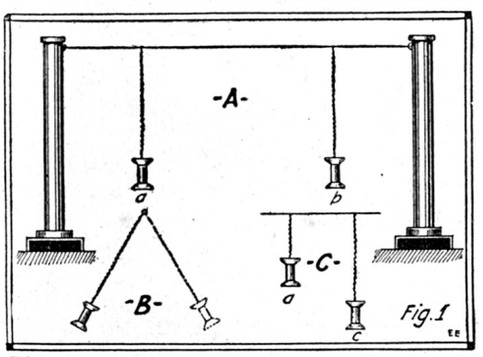
The Field of an Electron Moving at High Speed Is Distorted and the Mass Increases With the Speed.

Experiments in Physics

By JOHN J. FURIA, A. M.
DEPARTMENT OF PHYSICS, N. Y. UNIVERSITY

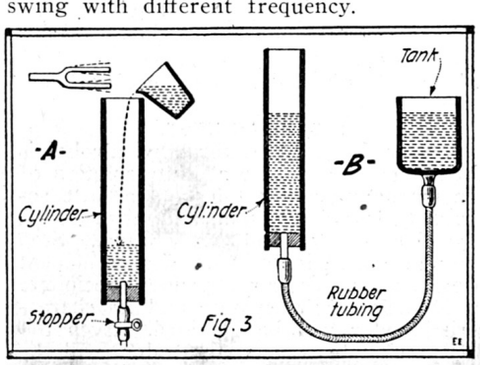
NO. 5 RESONANCE AND TUNING.

FOR the first experiment stretch a string about two feet long between two rigid supports, make two pendulums of the same length (about 12 inches) by attaching a spool to a string, as shown, and then attach the im-



This Experiment Illustrates a Simple and Very Striking Phenomena in Tuning. It Comprises Two Spools or Weights Supported from Strings, as Shown. With Equal Strings, Swinging A Will Cause B to Start Swinging, After Which This Will Die Down and A, Which Has Come To Rest, Will Start Swinging Again, Etc.

provised pendulums to the stretched string about six inches from the supports, (see Fig. 1) making sure that the lengths of the pendulums remain equal. When both pendulums are at rest, start one swinging by displacing it perpendicular to the stretched string, to which they are attached. It will be noticed that if for example *a* is the one made to swing its swings will gradually die down and simultaneously *b* will commence to swing of itself. Finally a point will be reached when *a* comes to a standstill and *b* has a maximum swing. Then *b's* swings will gradually die down and *a* will swing again. The process will continue almost indefinitely. Remove one of the pendulums from the string support, and in its place put a similar pendulum, the length of which is considerably greater (about 18 inches) (see Fig. 1-C). Now start *a* swinging again. *A* will be found to swing almost indefinitely, while *c* remains practically at rest. Start *c* swinging with *a* at rest. *C* will be found to swing almost indefinitely, while *a* remains at rest. If the two pendulums of unequal length are allowed to swing by supporting them by hand, it will be found that the period of swing is different, whereas the period of swing of the two pendulums of equal length will be found to be equal. This is equivalent to saying that the equal length pendulums swing with the same frequency, and the pendulums of unequal length swing with different frequency.



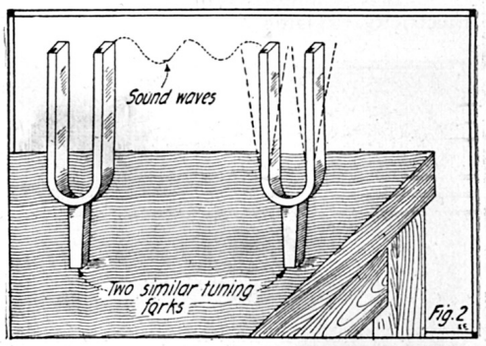
Even Water May Be Made Resonant or Subject to Sound Wave Effects, as Here Shown, and at A the Natural Period of Vibration of the Air Changes as More Water is Poured From the Beaker at the Top. If One Blows Across the Mouth of the Cylinder the Air Column Will Respond and Give a Clear Note.

Tune two strings of a stringed instrument (mandolin, violin, guitar, banjo, ukelele, etc.) to the same pitch*. Start one of the strings vibrating by plucking it. The other will be found to vibrate. Raise the dampers of the piano strings (push down loud pedal) and sing a strong clear note near the piano. The piano will be found to continue sounding the same note after the voice is silent, i.e., the strings corresponding to that note have been set in vibration by the voice note. Set a tuning fork in vibration by striking it. Place the bottom of the fork on the table and the sound will increase in intensity. If now another tuning fork of the same pitch is placed with its bottom on the table and the first taken away, the note will still be heard clearly, i. e., the second fork is now vibrating. Fig. 2. (This experiment can be performed fairly well using table forks instead of the tuning forks). If in part one of this experiment, the two strings are not tuned, and they are not at the same pitch, plucking the first string will not set the second vibrating. If in part two, the damper is removed from only one note of the piano and a note of different pitch is sung, the piano string will not be set into vibration. If in part three, the two tuning (or table) forks are not of the same pitch, the second fork will not be set into vibration by the first. The reader should note the similarity between the three parts of this experiment with each other and also with experiment one of this lesson.

If water is gradually poured into a tall cylinder (See Fig. 3-A) a sound of definite pitch is heard. As more and more water is poured in the pitch of the sound becomes higher and higher. Note that as more and more water is poured in, the air column, the vibration of which causes the sound, becomes smaller and smaller. The air column has a natural period of vibration, i. e., a definite frequency, and responds to any noise in the vicinity which contains a component vibration of the same frequency. If one blows across the mouth of the cylinder, the column will respond and give a clear note for any definite length of air. (The noise produced in blowing containing a component corresponding to the natural frequency of the column). Set a tuning fork in vibration above the cylinder as in Fig. 3-A, at the same time gradually pouring water. A point will be found where the sound of the tuning fork is greatly increased in volume. The column at this point is vibrating with the same frequency as the fork. If more water is poured in another point will be found (if the cylinder is long enough), etc. If two are performing the experiment, a better procedure to follow is for one to hold the fork in position while the other can let the water out slowly thru the stopcock (Fig. A), beginning with the cylinder full. If measurements are desired and the *resonant* column is to be measured, more exact points can be located, using the set-up in Fig. 3-B, where a slight motion of the tank will raise or lower the level of the water in the cylinder the desired amount.

Let A and B in figure 4 represent two Leyden jars of approximately equal capacities. A thick conductor (wire) joins the outer coating of A with its inner coating thru the spark gap G. B has its outer coating joined with the inner thru conductors *a, b,* and *c,* and spark gap *g,* this gap being very small, say 1/32 inch, while G is about 1/8 inch. The two Leyden jars are insulated from each other and placed 6 or 8 inches apart. Charge A up by means of a Wimshurst static machine or by a spark coil. (Note that the size of the conductor for B can be varied by sliding *b* back and forth.) With the two cir-

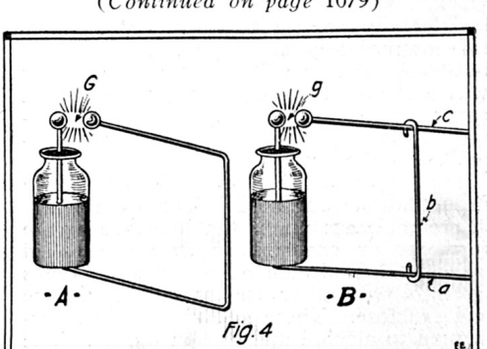
*Note that the pitch of a note is an indication of the frequency of vibration.



One of the Most Interesting Physical Experiments With Which All Students of Physics Should Be Familiar—That of the Two Tuning Forks, Whereby Sound Waves Set Up by Striking One of the Tuning Forks, Causes the Second Fork to Start Vibrating. This Holds True Only When the Two Forks Are In Resonance or of the Same Pitch.

cuits in parallel, a position will be found for *b* such that whenever jar A discharges thru the gap G, jar B will discharge thru the gap *g,* in spite of the fact that no energy is fed into B. If the jars have exactly the same capacity the position of *b* will be such as to make the dimensions of B's circuit equal to those of A's circuit. On changing the position of *b* the sparks will cease to form at *g.* Just as in the previous experiments whenever the natural period of an oscillator is the same as the natural period of a similar oscillator and one is set in vibration, whether it be mechanical, sound, or electrical, the first will cause the second to vibrate also. When the natural period of one is different from the period of the one that is vibrating (or from a component) the second does not vibrate. Varying the frequency of one object to make it equal to that of the object that is vibrating in order that the vibrating object will cause one at rest to vibrate is called *tuning,* and the vibration of one caused by the other is called *sympathetic vibration.* Small vibrations of one may cause large vibrations of the other object. Let us review some examples. The two objects are said to be in *resonance.* The weak old man who rings the old church bell, times his pulls on the rope so

(*Continued on page* 1079)



An Experiment Illustrating in a Vivid Manner the Fundamental Tuning Principle as Followed in Wireless Stations. If the Charged Leyden Jar A is Discharged, and Providing the Length of Copper Wire is the Same in the Circuit at B, Then a Spark Will Simultaneously Occur at the Small Gap "g", at Fig. B. This Secondary Circuit Can Be Tuned by Sliding the Wire B Along the Parallel Conductors A and C.

Practical Chemical Experiments

By PROF. FLOYD L. DARROW

ALCOHOL.

THE government ban upon the manufacture and sale of alcohol together with the consequent widespread use of poisonous wood alcohol in beverages, medicines and extracts makes a chemical knowledge of this subject of very great interest and importance. Even for industrial and educational purposes alcohol cannot now be purchased without the filing of a government bond and for the amateur chemist its purchase is absolutely prohibited.

Therefore the preparation of alcohol in the home laboratory for actual use in experiments becomes a matter of considerable importance. *Such preparation, too, is not illegal.*

PREPARATION OF ETHYL ALCOHOL.

Ethyl alcohol, or ordinary alcohol, also called spirits of wine and grain alcohol, is best made from molasses. Procure a large bottle, holding from 2 to 4 quarts, and pour into it 1 volume of molasses to 6 volumes of water. In a teacup make a thin paste of two yeast cakes and a little luke-warm water. Pour the paste into the molasses and shake the mixture thoroly. In order to determine the nature of the gas given off during the process arrange a small bottle containing a little limewater as shown in illustration 1. Now set the apparatus and contents in a warm place and allow the fermentation to proceed for about a week. Very shortly myriads of small bubbles will be seen to rise thru the mixture of molasses and yeast. As this gas bubbles thru the limewater the latter will become turbid, thus proving that carbon dioxid is one product of the fermentation. The alcohol of course remains in the bottle.

The chemical changes taking place in fermentation are these: The cane sugar in the molasses under the influence of the ferments or enzymes as they are called takes on a molecule of water and breaks up into two other sugars called glucose and fructose. These sugars are then fermented to alcohol and carbon dioxid. The equations for the reactions are:

$$C_{12}H_{22}O_{11} + H_2O = \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$$

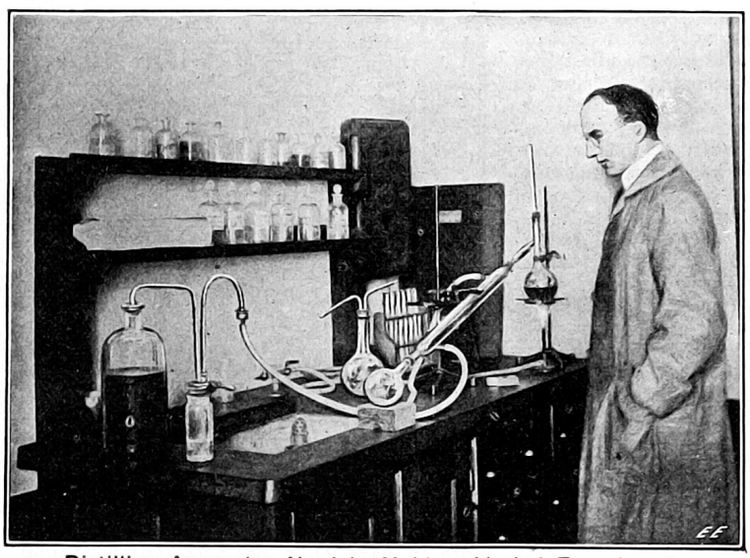
$$C_6H_{12}O_6 = 2C_2H_5OH + 2CO_2$$

DISTILLATION OF ALCOHOL.

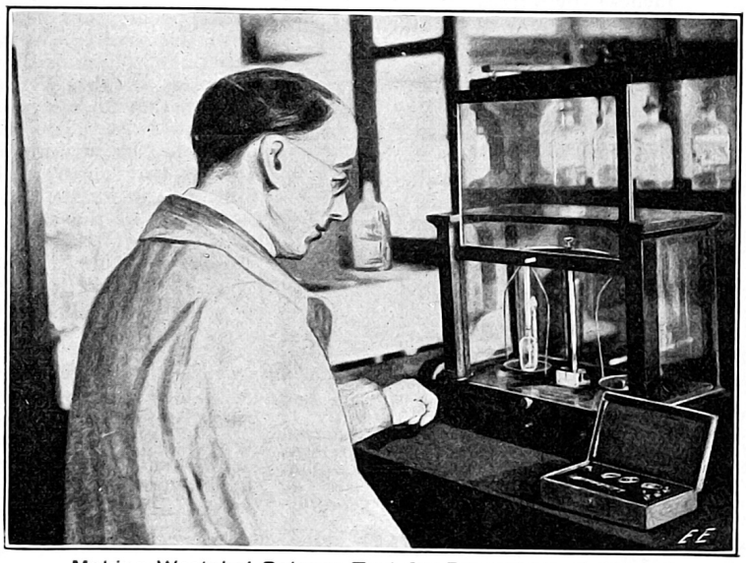
At the end of a week, or when the bubbles cease, arrange a boiling flask and condenser as shown in illustration 2. Siphon, or carefully pour off, enough of the fermented liquid to half fill the boiling flask. See Fig. 2. Insert in the neck of the flask a one-holed stopper and thermometer with the bulb just below the delivery tube. Regulate the flow of water thru the jacket of the condenser to a small steady stream and light the Bunsen burner. Bring the contents of the flask to boiling and note the temperature. This will be about the boiling point of alcohol and at first a distillate rich in alcohol and containing little water will pass over. Keep the flame down so as to prevent frothing and continue the distillation until a temperature of 99 degrees Centigrade is reached. As the temperature rises more water and less alcohol passes over.

Now pour the distillate into a large stoppered bottle and repeat the process with successive portions of the fermented liquid, until it has all been distilled.

But the first distillate will contain a large percentage of water and this must be removed. To do this rinse out the boiling flask and place in it a number of lumps of quicklime. Fill the flask half full of the first distillate and distil again, placing the second distillate in a glass stoppered bottle. Clean out the retort and repeat with another portion, continuing to do so until the first distillate has all been redistilled. The quicklime unites chemically with the water and the second product is very largely alcohol.



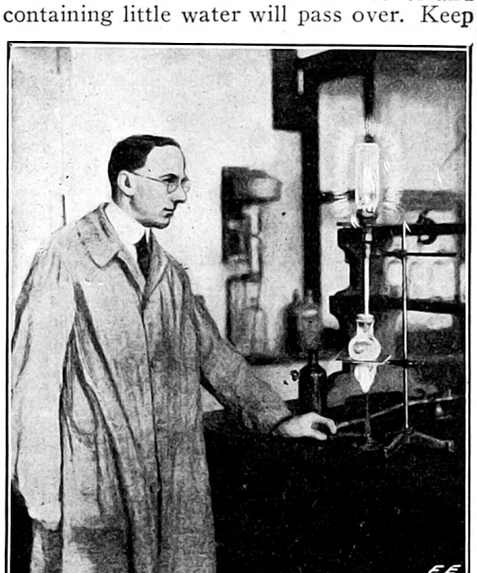
Distilling Apparatus Used in Making Alcohol Experiments.



Making Westphal Balance Test for Percentage of Alcohol.

New Chemistry Series

The publishers have great pleasure in announcing that they have arranged for a new series of EXPERIMENTAL CHEMISTRY papers, to be prepared by Prof. Floyd L. Darrow, Instructor in Chemistry and Physics at The Polytechnic Preparatory Country Day School, Brooklyn, N. Y. Prof. Darrow is the author of numerous articles and books on the subjects of Chemistry and Physics, and possesses a clear and very interesting style of writing on these topics, which we feel sure our readers will find a real treat.



Welsbach Mantle Test for Alcohol; the Mantle Lights if Over 12 Per Cent. is Present.

TESTS FOR ETHYL ALCOHOL.

To detect the presence of alcohol in beverages, medicines and extracts has always been a matter of commercial and chemical importance, but now with prohibition in force it is very much more so and it is also very interesting work.

First note the odor of the alcohol. Then place a little on a watch glass and apply a match. Try its solvent power on a bit of camphor gum or a crystal of iodin. Place a little of the alcohol with an equal quantity of acetic acid in a test tube and add a few drops of concentrated sulfuric acid. Heat gently and note the pleasant, ethereal, fruit-like odor of ethyl acetat, a substance which is much used in artificial flavoring compounds. What happens is this:

$$C_2H_5OH + H(C_2H_3O_2) = C_2H_5.C_2H_3O_2 + H_2O$$

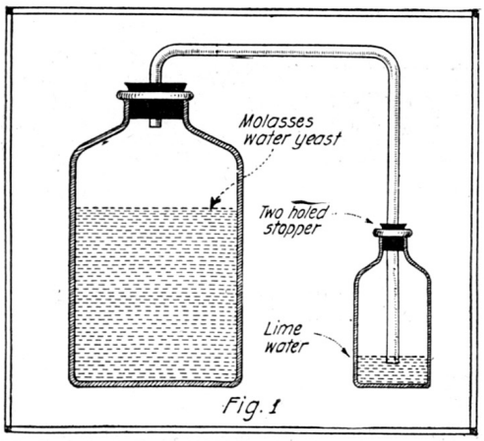
The sulfuric acid is used to absorb the water formed.

IODOFORM TEST.

A very delicate test for ethyl alcohol is the iodoform test. To a dilute solution of the alcohol in a test tube add a little sodium hydroxid solution and then iodin, crystal by crystal, and gently warm. Stop the addition of iodin short of a permanent brown color. Slowly a yellow precipitate of iodoform will separate and its characteristic odor will be obtained. Even tho no precipitate forms the odor will be present. This test can be applied to medicines and extracts, but it is best to distil a small portion and test the distillate.

AN ALCOHOL MEDICINE TESTER.

To one end of an 8-inch length of glass



Simple Apparatus Set Up for Carrying on the Fermentation of Molasses in Making Ethyl Alcohol.

tubing of proper diameter fit a Welsbach gas burner and mantle. Push the other end thru a one-holed stopper. In a flask place two or three tablespoonfuls of the liquid to be tested and insert the stopper and burner. Upon heating the flask gently, if alcohol is present in amounts larger than 12 per cent, the mantle will glow brightly when lighted.

TO DETERMINE PERCENTAGE OF ALCOHOL.

Arrange distilling apparatus as shown in diagram 3. For this distillation the delivery tube of the boiling flask may be bent in the flame of a Bunsen burner fitted with a fish tail tip.

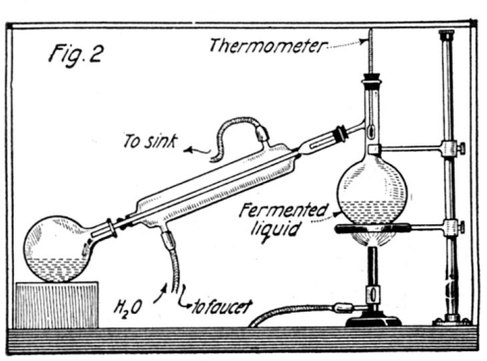
Measure into a graduate exactly 100 cc. of the medicine, beverage or extract to be tested and transfer it to the boiling flask. Rinse out the graduate with 50 cc. of water and add it to the flask. Introduce a small piece of leather to prevent frothing, and being sure that all connections are tight, distil off into a graduated cylinder about 90 cc. Then add enough distilled water to bring the contents to the 100 cc. mark. We have now practically a mixture of alcohol and water of the same volume as the original volume of liquid taken, and containing all the alcohol in the sample.

To find the percentage of alcohol we must know the specific gravity of the mixture to at least 4 decimal places. To determine this there are two principal methods. One is by use of a Westphal balance and the other by means of a pynknometer.

WESTPHAL BALANCE METHOD.

The balance is shown in Fig. 4. The plummet is first suspended in air from the hook at the end of the bar and by means of the leveling screw at the bottom the bar is brought into a horizontal position. There are nine divisions on the bar and with the balance are four sizes of "rider" weights.

Now suspend the plummet in the mixture of alcohol and water which you have distilled over and place weights on the balance arm until it is exactly horizontal.



Apparatus Set Up for the Distillation of Alcohol in the Laboratory.

Then suppose the largest weight stands at 9, the next size also on 9, the third weight on 2 and the smallest on 4. Such being the case the specific gravity is .9924.

Then to get the percentage of alcohol look in a table of alcohol percentages and opposite the specific gravity found will be the percentage both by volume and by weight.

THE PYNKNOMETER METHOD.

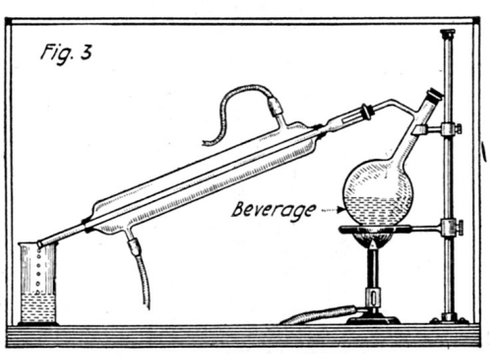
A pynknometer is a small specific gravity bottle holding exactly 25 cc. or grams of water at a definite temperature, and carrying in the stopper a small thermometer for regulating this temperature.

The bottle is weighed on an analytical balance empty and dry. It is then filled to the top of the overflow tube with the liquid to be tested, the stopper inserted and the cap fitted on the overflow tube, see Fig. 5. After wiping dry, the bottle and contents are weighed and from this weight is subtracted the weight of the empty bottle. If the temperature has been regulated to 15.6 degrees centigrade, this difference will be the weight of exactly 25 cc. of the liquid. Therefore, the specific gravity is found by dividing this difference by 25 after which the percentage of alcohol is determined as before by reference to the tables.

It will be found very interesting work to determine the percentages of alcohol in drugs, etc.

WOOD OR METHYL ALCOHOL.

Wood alcohol, obtained in the destructive distillation of wood as a by-product in the manufacture of charcoal, has always been used as a substitute for ethyl alcohol and



Special Distilling Apparatus for Determining Per Cent. of Alcohol.

now with prohibition this use has become alarmingly widespread. Therefore, to be able to detect its presence is of great importance. The formula of methyl alcohol is CH_3 OH, while that of ethyl alcohol is C_2 H_5 OH, the two differing only by a CH_2 group. It is very frequently found in Jamaica ginger, lemon extract, peppermint, "hot drops," liniment, bitters, toilet waters, spirits of camphor and cheap whiskey.

TEST FOR METHYL ALCOHOL.

Cut a 3-foot length of No. 14 copper wire and starting about 10 inches from one end wind the wire as closely as possible about a lead pencil stopping 10 inches from the opposite end. Bring the first end thru the coil and twist the two ends together to make a handle. See Fig. 6.

To learn the test, make a solution of one part of methyl alcohol to six parts of water and pour 10 cc. into a test tube placed in a bottle of cold water to keep it cool. Now heat the copper coil in the upper hot oxidizing portion of the Bunsen flame to a dull red and quickly plunge into the contents of the test tube. Repeat the operation six times. The copper oxid formed in the Bunsen flame oxidizes the alcohol to formaldehyd which is left in the solution.

Then to confirm the presence of formaldehyd and therefore of methyl alcohol apply the following test: Add one or two

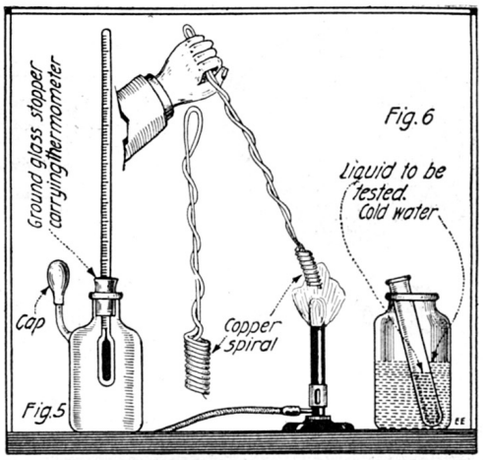


Fig. 5. The Pynknometer for Determining Specific Gravity of Alcohol. Fig. 6. Apparatus Used in Testing for Presence of Wood Alcohol.

drops of the above solution to 10 cc. of milk and mix well. In another test tube put 4 cc. of a solution containing twenty-five volumes of concentrated sulphuric acid to one volume of ferric chloride solution. Now very carefully pour the milk down the side of the second test tube, inclining the tube so that the milk shall rest on the surface of the acid. In the presence of formaldehyd a violet ring will be formed at the contact of the two liquids. This is a very delicate test, and if much formaldehyd is present, use more milk. Now test beverages, extracts, witch-hazel, etc., for wood alcohol. It is always best to make the formaldehyd test before testing for alcohol so as to be sure that formaldehyd is not already present. In highly colored or flavored extracts, it is frequently better to distil off a small portion and test the distillate.

TEST FOR METHYL ALCOHOL IN PRESENCE OF ETHYL ALCOHOL.

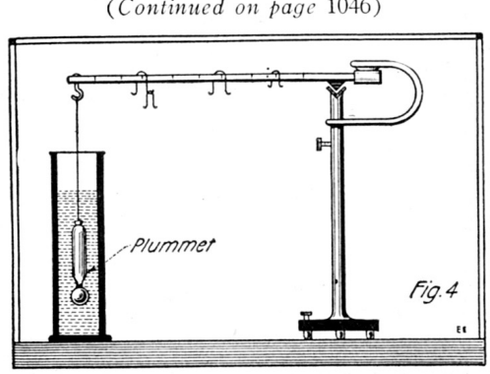
Denatured alcohol contains about 10 per cent of wood alcohol to render it unfit for use in beverages. The two are also frequently found together in extracts, etc.

In the presence of ethyl alcohol oxidize the alcohols with a hot copper coil as before, but before making the formaldehyd test, boil the solution in the test tube very gently until the odor of acetaldehyd has disappeared. Acetaldehyd is formed by the oxidation of ethyl alcohol just as formaldehyd results from the oxidation of methyl alcohol. It has a pungent, ethereal and suffocating odor which will not escape detection. After satisfying yourself of the absence of acetaldehyd proceed with the formaldehyd test as before.

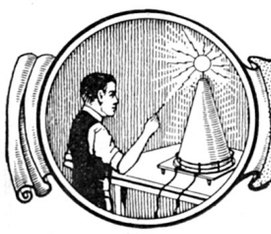
PREPARATION OF METHYL SALICYLATE OR OIL OF WINTERGREEN.

In a test tube put a small pinch of salicylic acid. Add a drop of methyl alcohol and about twenty drops of concentrated sulfuric acid. Warm the mixture very gently and shake the test tube as you do so. The odor of oil of wintergreen is at once apparent.

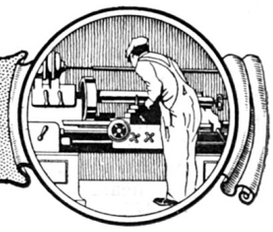
(*Continued on page* 1046)



The Westphal Balance for Determining Specific Gravity of Alcohol.

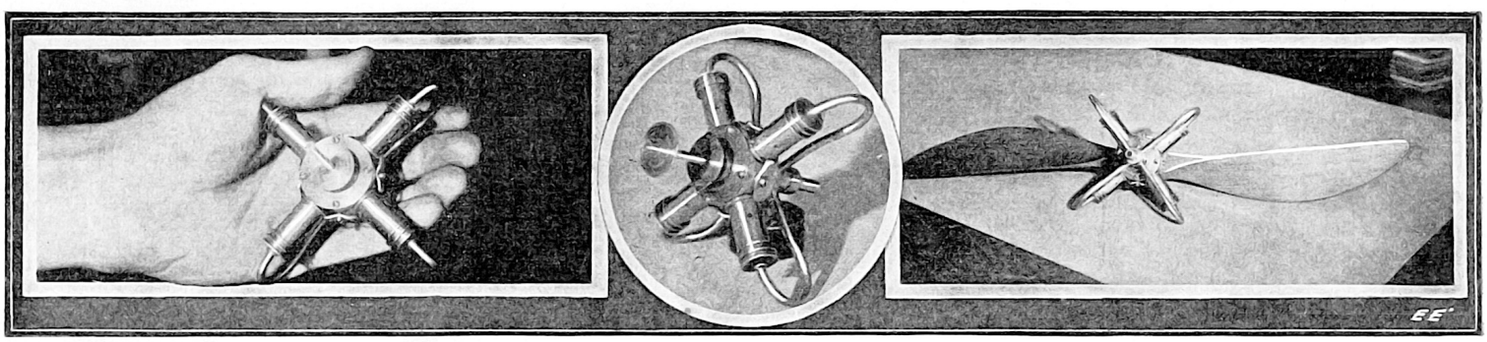


THE CONSTRUCTOR



Rotary Motor for Model Airplanes

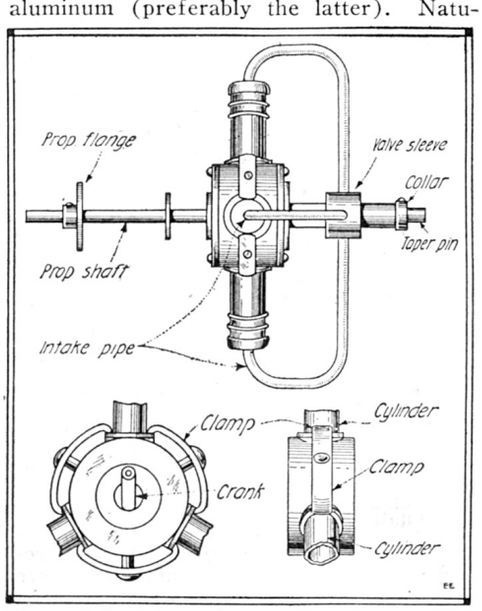
By WILLIAM J. BEACH



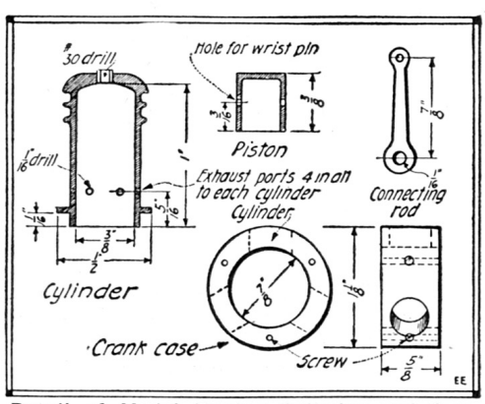
TO the constructor of model airplanes no feature of the work is such a drawback as the power plant. The use of rubber strands is in no way suitable for reproduction or scale model work; such a method of propulsion necessitates a long and out of proportion fuselage and further does not permit the wings or planes to be placed in correct position. When we say that rubber provides a maximum of power for weight, we have explained all its virtues; hence, we find ourselves turning to the use of miniature engines, the power for which may be obtained from several sources such as flash steam, carbonic acid gas, liquid carbonic acid, or comprest air, preferably the latter, since it is the simplest and least expensive method.

The following describes a motor which is a perfect mechanism and which will spin around and *drone* like a "Gnome" or "Clerget" and give a maximum of efficiency if the most suitable propeller or tractor screw is fitted to it.

The cylinders are machined from ½-inch cold rolled steel, being reamed and polished to the last degree of smoothness—the pistons may be made from either brass or aluminum (preferably the latter). Naturally the pistons must be a perfect fit which is accomplisht by a lapping process. The exhaust ports are drilled in the cylinders before the lapping and polishing takes place. The connecting rods are made from brass 1/16-inch thick. The crankcase is made from aluminum, the front and back being made from brass.



View of Completed Comprest Air, Model Airplane Engine.



Detail of Model Engine Cylinder and Connecting Rod.

The propeller shaft is made from a piece of cold rolled steel ½-inch in diameter and soldered to the front plate.

The valve sleeve is turned from ¾-inch C. R. steel and the valve and crankshaft are made from a No. 5 taper pin.

The intake pipes are from brass ⅛-inch outside diameter.

To make a clean bend in the pipes, heat the same red hot, and instantly dip in water when the brass will readily bend around any suitable mandrel. The clips holding the cylinder to the crankcase are from spring steel. No. 2-56 screws are employed thruout for holding all parts together.

This engine may be timed to run clockwise, or anti-clock-wise, which is governed by the position of the slot in the taper pin, which in either case should be vertical with the crank throw and so set that the pistons will have a fraction of a lead, or in other words air may be communicated to the cylinders a little before the pistons reach dead top center.

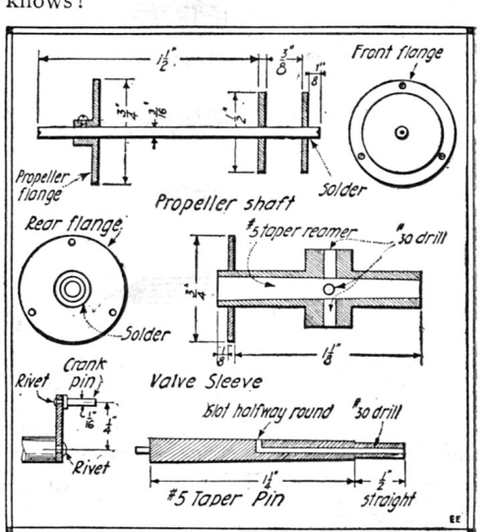
When soldering the intake pipes to the valve sleeve, care must be taken not to allow any solder to adhere to the taper pin and thus freeze it to the sleeve.

In building the engine, all parts as far as practicable should be turned between centers. For instance, the crankcase and front and rear flanges should be all turned together on a mandrel made specially to receive the three parts at the same time.

When completed the engine should be submerged in oil and then taken out and placed in the lathe and run in until it may be spun freely with the fingers. This engine when completed weighs under three ounces and will turn a 12-inch to 14-inch propeller nicely.

In the use of comprest air motors for model airplane work, the tank or air reservoir should be made as light as possible, and given diameter in preference to length. A proper construction must be followed out or disastrous results will ensue. A tank should be around 30 inches long by 4 inches in diameter and made from 5 mil phosphor bronze 6 inches wide and riveted every ¾ inch, likewise the domed ends. The entire tank should be wound with the finest gage piano wire at the rate of eight turns to the inch. Having wound the tank with the wire this should then have the soldering iron wiped straight along it at three points around the tank to prevent the wire from slipping when expansion takes place.

The matter of a well constructed tank is of the utmost importance—the writer knows!

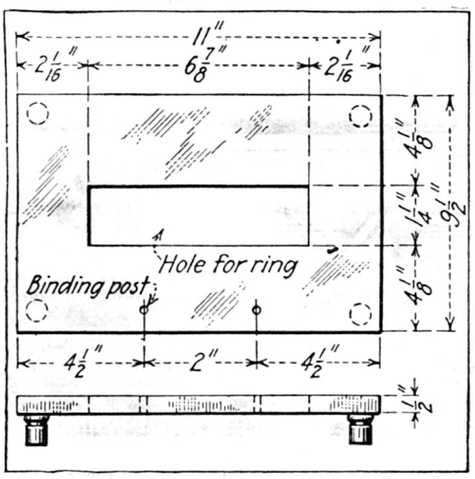


Detail of Propeller Shaft and Flanges.

Building a Tangent Galvanometer

HEREWITH I present drawings and specifications for building a tangent galvanometer, which nearly all amateur experimenters will find useful and which will measure an electric current from .088 to 1.375 amperes accurately, if the dimensions are carefully followed. No nails, iron or steel screws should be used.

From a piece of white wood cut out a



Above There is Shown a Sketch of Wooden or Fiber Base for the Tangent Galvanometer.

ring ⅝ inch thick by 9 inches inside diameter by 10½ inches outside diameter. Next cut two rings from the same kind of wood, whose inside diameters are 9 inches, outside diameters 11 inches and ¼ inch thick. Glue them on both sides of the first ring to hold the wire in place. When the glue is dry, wind eight turns of No. 16 D.C.C. magnet wire on the middle ring and twist the two ends together so that when assembled they will come under the base to the binding posts. A keyhole saw can be used to cut the rings. Two pieces of wood 11 inches by ⅝ inch wide and ¼ inch thick are screwed on both sides of the completed ring in the center, as shown in the drawing, and exactly in the center of the two pieces a groove is cut to fit the compass, which should be no smaller than 1¼ inches in diameter. Use only brass screws.

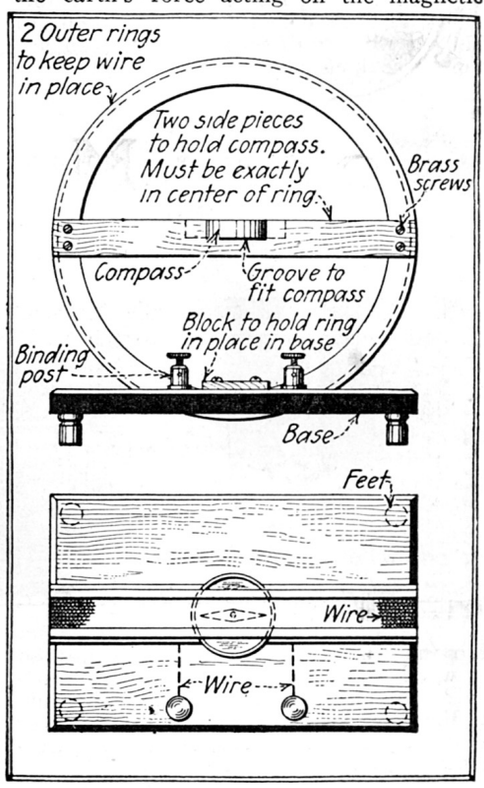
The base is made from a piece of wood ½ inch thick by 9½ inches wide and 11 inches long. Cut in it a hole 1¼ inches wide, 6⅞ inches long for the ring with the coil to fit in.

When finished, drill two holes for the binding posts, as shown, and insert four Moore glass push-pins to be used as feet, because the ring will come below the bottom of the base. Sandpaper it and give one or two coats of varnish or shellac, which will add greatly to the appearance of the instrument. A small block is fastened over the ring where it passes into the base to hold it stationary.

To use the galvanometer, remove all magnets, iron or steel, away from it, and turn the galvanometer so that the needle when pointing *North* is exactly in the center line of the coil. The deflection caused by an electric current going thru it is equal to a certain fraction of an ampere, as will be noted in the following table:

Angle	Current
10 degrees	.088 Amp.
20 "	.182 "
30 "	.289 "
40 "	.420 "
45 "	.500 "
50 "	.600 "
60 "	.865 "
70 "	1.375 "

The table here given will only be suitable for places east and north of Chicago, since the earth's force acting on the magnetic



Side and Top View of the Tangent Galvanometer, Which is of Use to Every Experimenter.

needle varies at different places. For positions west and south of Chicago, the values obtained must be multiplied by 1.3.

Contributed by JOHN DZUGAN.

Simple Microphotographic Apparatus

HEREWITH is a microphotographic apparatus which I constructed recently, while employed in a hospital laboratory. Photographs were necessary in the study of an extremely important pathological lesion. No microphotograph apparatus being available, I hastily constructed, or in other words, assembled, the following apparatus:

1 4"x3" Premo camera.

1 Standard high power microscope.

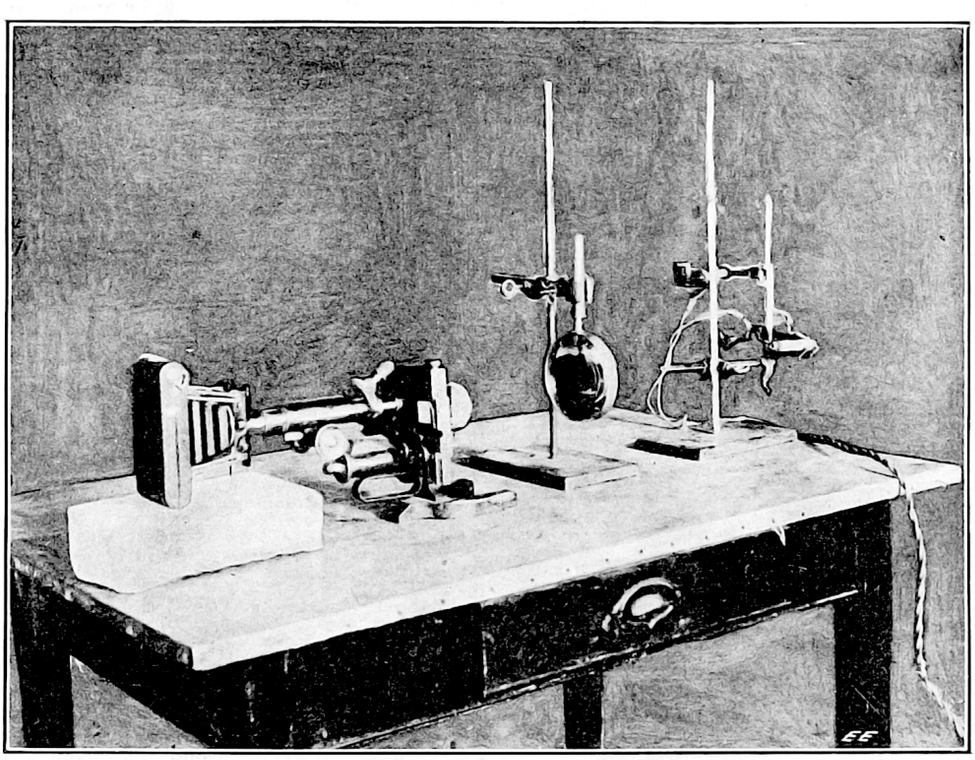
1 Condensing lens (a large reading glass being employed, supported by a ring-stand).

1 Arc, constructed of a ring-stand.

1 Adjustable resistance, which was made of common bale wire.

The pictures taken were extremely satisfying.

Operation:—No lenses were used in the camera. The ocular of the microscope was introduced directly into the lens places on the camera. The arc being started, a slide introduced on 'scope stand, and condenser being focused accurately on slide, it was then necessary to introduce a ground glass in place of adapter in camera and adjustments made for focus with micrometer adjustment of microscope. When the object was seen with sufficient distinctness on a ground glass, a sensitized plate was introduced. The exposure of the plate was controlled by a sheet of black paper between the condenser (reading glass) and the stand of the microscope. The plates were exposed 5 seconds and developed in the usual way. Positives were then printed and when colored with Eastman's water colors gave really extraordinary results. Considering the simple and inexpensive apparatus employed and the short time required to set up the instruments, the results obtained were fine indeed. Experimenters in general will find this branch of science most interesting and instructive.

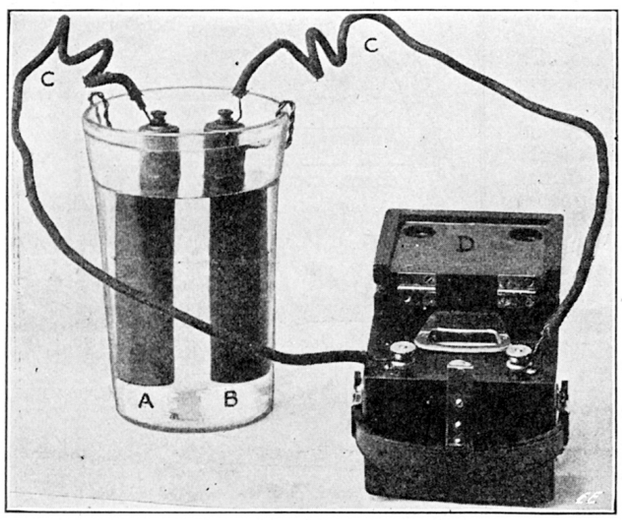


The Microphotographic Apparatus Here Illustrated, Comprises a Few Readily Procurable Apparata and Will do Very Good Work Indeed. A Camera, a Microscope, a Large Reading Glass and an Arc Light, Constitutes the Apparatus Required.

Contributed by WARNER N. CROSBY.

Electricity from the Thermo Cell

NOT long ago scientists and inventors alike predicted the generation of electricity direct from heat (combustion of coal, etc.) as a means of putting the steam engine into the "scrap pile." But tho the thermo-couple generating method is worth mentioning, did it prove successful? Having many drawbacks, and owing to the great loss of energy, hardly two per cent of heat are transformed into electricity.



A Very Interesting Thermo Cell With Which Some Little Known Experiments Can Be Made. By Heating One of the Carbons A or B and Plunging it Into the Electrolyte, a Current is Produced; But if Both Carbons are Heated to the Same Temperature and Plunged Into the Liquid, no Current is Indicated on the Galvanometer.

One day while experimenting on thermo-electricity, I was lead to believe, by so proving, that electricity can be generated by two conductors immersed in the water, provided there be a difference in temperature between the carbons and the water.

The discovery of this thermo-cell, which I will make clearly understood, is far more powerful than a thermo-couple.

The photo shows the thermo-cell in its simplest form, with its various details, easily within the reach of every experimenter. A and B are two dry battery carbons immersed in a vessel of water, connected by the conductors C, to the galvanometer D, by which a closed circuit is made. Now by removing carbon A, heat it merely by holding it in the hand, plunge it back into the liquid, and have the remainder of the vessel the same degree of temperature as that within the room; you will note an electric current passing from B thru the liquid to A and outer circuit, back to B.

By heating one of the carbons to about 200 degrees Fah., I was able to obtain as much as .50 of a volt. The amperage is fairly large, usually as large as in a voltaic cell, but the great resistance of water does not permit it to flow thru the circuit.

The flow of the electric current continues as long as there is a difference in temperature between the carbon or carbons and the surrounding water.

In the place of carbons, any conductors can be substituted; metals will do as good. I have employed a shunted 563 ohm Weston galvanometer in my experiments, but a voltmeter capable of measuring an hundredth part of a volt, will answer as well.

As we know that even the heat of the hands is enough to manifest an electric current, then the thermo-cell ought to be more interesting than a thermo-couple, and beside there is a possibility of its becoming a success in the near future, if fundamental improvements are possible, so as to employ a different liquid better adapted for the purpose than acidulated water. Otherwise, as far as I have gone, the thermo-cell will remain as merely an interesting experiment, and more important for explaining its effect on metal construction.

Contributed by VINCENT POMPI.

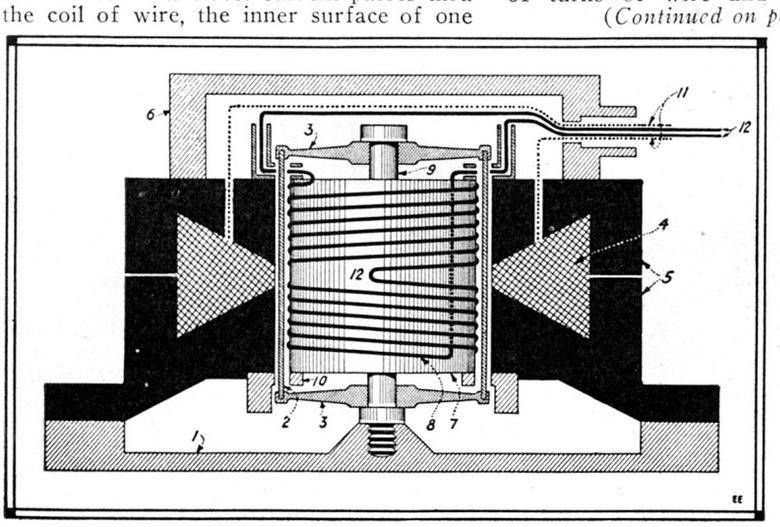
The Fessenden Oscillator

By E. T. JONES

THE field magnet of the Fessenden sound oscillator consists of two steel recest rings clampt together with a coil of wire in the space formed by the recesses. When a direct current passes thru the coil of wire, the inner surface of one ring becomes a North pole and the other a South pole.

The core consists of a steel cylinder, upon which are wound the proper number of turns of wire and rings for rigidly

(*Continued on page* 1090)



No. 1, Diafram 30 Inches in Diameter. 2, Movable Conductor (Copper Tube). 3, Flexible Discs, Holding "2" to Axis "9". 4, Field Coil. 5, Iron Field Magnet. 6, Oscillator frame. 7, Armature, Iron Core. 8, Armature Winding (Winding Reversed at "12"). 9, Rod (Imparting Motion to Diafram). 10, Ring, Preventing Side Motion and Supporting Core. 11, D.C. Field Windings. 12, A.C. Armature Windings.

AN ELECTRIC OVEN EASILY CONSTRUCTED.

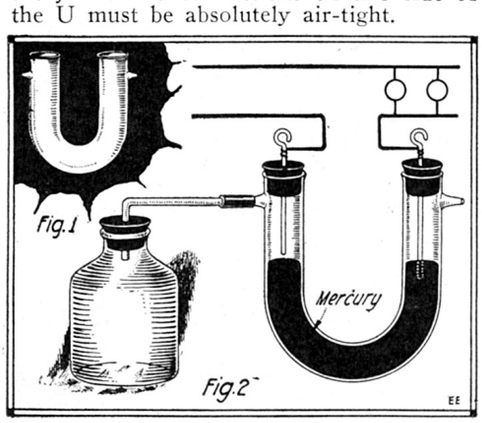
SINCE so many boys and young men are equipping their own laboratories and workshops, it is scarcely necessary to mention the great need of an electric warming oven in any chemical laboratory. Many of us have doubtless realized this need of an oven which would maintain a temperature of 100° C. without attention.

The oven should be protected from excessive loss of heat by some heat-insulating cover. An excellent method of accomplishing this is to cut pieces of felt the proper size and glue them to the sides, top, bottom and door of the oven. One layer of felt is good; two layers are more satisfactory. Two layers of felt with a layer of straw-board between gives fine results.

The heating element is simply two carbon filament lamps mounted in sockets on or near the bottom of the oven. If the heat insulation is very good one 32c.p. carbon lamp will be sufficient.

For the regulator a very small U-tube (Fig. 1) must be procured. This may be bought from any chemists' supply store for twenty to thirty cents. By means of a small piece of glass tubing which has been heated and bent to a right-angle connect a two-ounce bottle or better test-tube to one of the side tubes of the U. A rubber stopper and bit of rubber tubing will solve it.

Thru another rubber stopper placed in the open end of the U-tube a stout copper wire is inserted and extended half way down the tube as shown in Fig. 2. All of the joints and connections on this side of the U must be absolutely air-tight.



To Make a Satisfactory Electric Oven, a Metal Cracker Box is Used. You Will Need a First Class Electric Heat Regulator and the One Here Illustrated Has Proven Very Satisfactory for Such Purposes in the Laboratory.

Thru the other side of the tube mercury is poured until it touches the copper wire. A second piece of copper wire is placed in this side and run well under the surface of the mercury. The mercury-tube together with the attached bottle is set up at the back of the furnace where it will be out of the way. The two copper wires are connected in series with the lamp or lamps just as any other switch would be connected. Connection is made to any lamp socket by means of flexible wires and a plug.

Finally the current is turned on and the temperature is watched. Soon the air in the bottle will begin to expand. The mercury will be deprest and the circuit broken. After the furnace has cooled a little the air will contract, the mercury will rise and the lamps will be turned on again. If the temperature is not high enough when this occurs the wire should be lowered a short distance at a time until the desired temperature is reached. Should much sparking occur at the break, a drop or two of oil should be placed on the surface of the mercury.

One of these automatic regulators, built by the writer, gave excellent regulation while in daily use for several months.

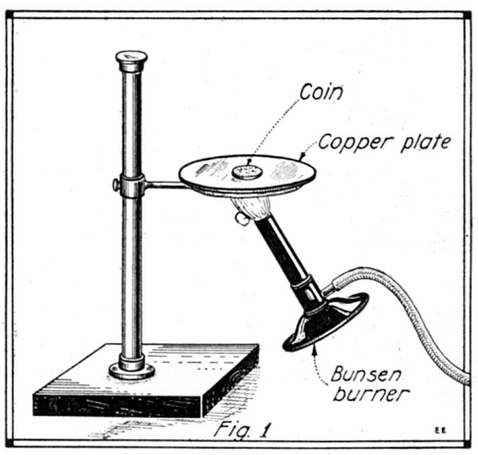
Contributed by
DAVID CLARKE COX, M.A.

Experiments in Thermography

By THOMAS W. BENSON

AS the name would imply, these are experiments in "firewriting." As a matter of fact they demonstrate the effect of heat radiations on a surface to alter or control the tendency of vapor to condense on that surface.

A very simple experiment can be made



Novel Experiment in Thermography—a Silver Coin Is Placed on a Polished Copper Plate and Heated. After Cooling and by Breathing on the Plate, the Image of the Coin Will Be Clearly Seen.

by placing a silver coin on a polished copper plate and passing a spirit lamp or Bunsen burner under it to slightly heat the plate and then allowing it to cool. On examination, the plate, if not heated too much, will show no marks on the surface. However the surface of the plate where the coin rested has been affected in some way that alters its tendency to condense moisture. By breathing on the plate the impression of the coin will be seen clearly defined in drops of watery vapor.

Exposing the plate to vapors of iodine or mercury will have the same effect and make the outline more permanent.

To obtain a good image, the coin or other substance must be of a different material from the plate. Thus should a penny and a nickel be put on the plate and heated, only the nickel would be reproduced in the condensed vapor.

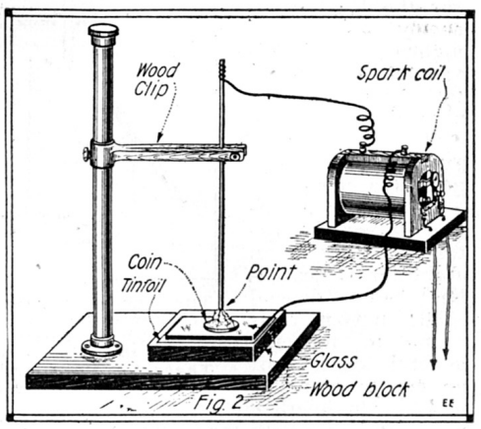
Take a glass plate and lay it on a sheet of tinfoil or other conductor. Place a coin or other metal object in the centre of the glass plate. Connect the tinfoil to one terminal of a spark coil or static machine and bring a wire from the other terminal close to the coin and permit sparks to jump for a few seconds. Remove the coin quickly and breathe on the surface of the glass, when the impression of the coin will become visible.

If several plates of glass are superposed, a coin laid on the top plate and sparks passed to the coin a similar impression will be found on the top surface of each plate when breathed upon.

Another method of obtaining the same result is to place a mirror in the sun with a coin laid on the surface for several days. On removing the coin carefully and breathing on the mirror a fairly clear outline of the coin will be reproduced.

A rather mystifying experiment in thermography can be performed as follows: Take a sheet of copper and amalgamate by rubbing with nitrate of mercury to give a brilliant reflecting surface. A sheet of printed paper is laid face down on the copper and pressed into close contact with several thicknesses of paper and a weight. Place the whole on a warm surface for a half-hour.

On removing the paper no change will be noticed on the amalgamated surface. However it has been affected in some manner by the dark and light areas of the paper. This effect is made visible by exposing the plate to mercury vapor which will condense on the parts of the plate for-



A Spark Coil Is Used to Conduct This Experiment With. A Coin Is Placed On a Glass Plate, As Shown. Removing the Coin and Breathing On the Glass Brings Out the Image of the Coin.

merly in contact with the white area of the paper. Then by exposing to iodine vapor the parts will be blackened where the mercury did not condense, thus giving a clear reproduction of the printing.

These are but a few of the many experiments possible, for by trying various substances and materials strange and unexpected results will be obtained that may find a practical application.

Making an Electrical Swing

By Prof. LINDLEY L. PYLE

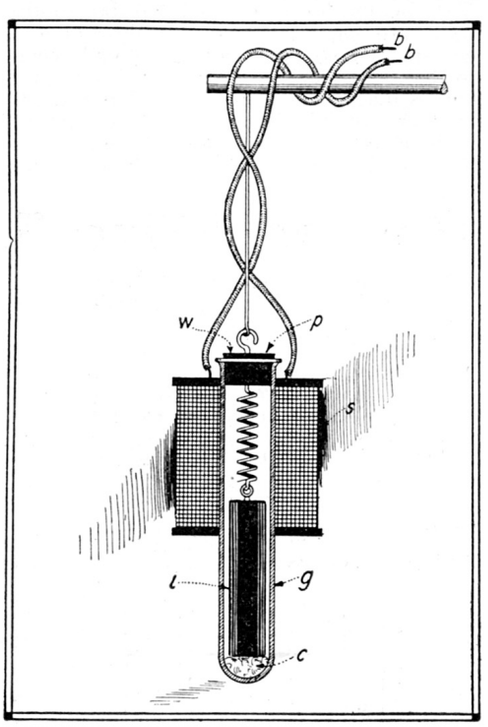
EVERY one is familiar with the method of "working up" in a swing. Any boy may construct an "electrical swing" that may be made to "work up" by the mere tapping of a distant key. Obtain a four-inch length of quarter-inch glass tubing (inside diameter) sealed off at one end. (A small test tube will do.) Pack a piece of cotton into the bottom. Find a piece of soft iron half as long as the glass tube and about three-sixteenths of an inch in diameter. (A bundle of iron wires cut to the proper length will be satisfactory.) Suspend the piece of iron from a coiled spring attached to a cork thrust into the top of the glass tube. Details may be seen in the accompanying drawing. The spring may be home-made, wound of No. 30 brass, steel, or German silver wire, such that when unloaded it is about one inch in length and when loaded with the iron it elongates just enough to allow the iron to rest upon the cotton cushion.

Next wind five layers of No. 24 insulated copper wire upon the upper half of the glass tube, allowing two or three feet for the free ends of the wire.

Fasten a string (or thread) a foot long to the upper end of the coiled spring (which is thrust thru the cork), and suspend the whole device to swing as a pendulum.

Wind the free ends of the solenoid winding *loosely* around the supporting string and support, and then extend them to a tapping key and a couple of fresh dry cells in series.

Start the apparatus to swinging gently by a touch of the finger. Close the key every



An Interesting Electrical Device, Called a "Swing" and Which Resembles In Its Action the Common Swing. (g) Glass Tube; (i) Soft Iron; (c) Cotton Cushion; (s) Solenoid; (p) Cork Plug; (w), Sealing Wax; (b, b) To Be Connected to Two Dry Cells and Key.

time the device swings thru its lowest (or bottom) position, both "coming" and "going." The magnetic field set up by the momentary current thru the solenoid lifts the iron at the middle of the swing and the release of the key allows the iron to drop at the ends of the swing, and the apparatus "works up" beautifully into vigorous motion. The best way to learn the proper moment to work the key is for the operator to stand up in a rope swing and watch while he "works up," for the position in his to-and-fro travel at which he *lifts his own body* by his leg action.

Violent oscillations of the electrical swing may be quickly cut down to *moderate* oscillations by the proper manipulation of the key. The operator should also study the key action for this case by watching his own body while making his rope swing "die down" quickly by forced body action.

By giving the transparent walls of the glass tube an exterior coat of black paint the apparatus may be made to appear very mysterious to an audience, especially if the wiring and key be concealed.

The reader is of course aware that the tension in the coiled spring makes it easier, so to speak, for the magnetic field to bring about the lifting of the iron core. The glass tube is sealed at the bottom in order that upon the descent of the iron core it (the iron) may not drop past its normal position and interfere with the proper action of the device; also oscillations of the piece of iron are prevented.

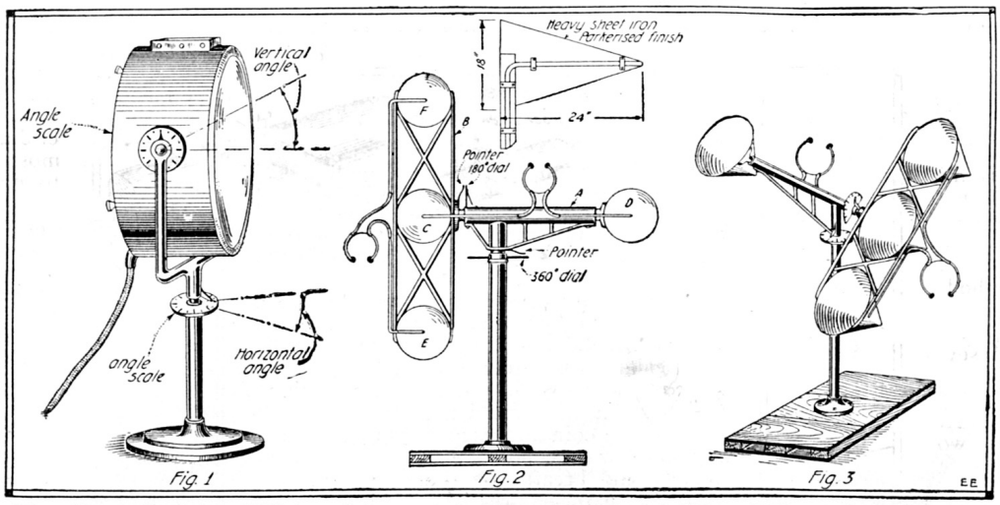
Readers interested in the mechanics of "working up" in a swing may find excellent discussions in *Science* for July 4, July 18, and August 8, 1919.

The Horn Type Sound Locator

By CHARLES K. FANKHAUSER, JR.

THE following article is a description and explanation of the principles of operation of the type of sound locator widely used by the British anti-aircraft forces for the location of enemy aircraft at night. Several advantages are claimed for it over the paraboloid type, the chief ones being portability and greater accuracy.

Until the invention of sound locators the crew of an anti-aircraft searchlight had to depend solely upon their ears to tell the general location of an enemy plane at night. This method was very unsatisfactory and necessitated the searching of a large area of the sky. Then came the horn type of sound locator.



The Above Drawing Will be of Interest to "Boy Scout" and Other Military Organizations in That It Shows the Details of the Horn Type of Sound Locator Employed by the Allies for Spotting Enemy Air-Craft at Night. When the Spotter, who Listens for the Sound, Reads the Direction of the Enemy on the Dials, He Informs the Searchlight Operator of These Readings, and the Latter Instantly Swings the Beam of Light in the Indicated Direction of the Enemy, Without Wasting Time in Sweeping the Skies With It.

First, let us consider the theory of locating sound. When one hears a sound there is generally no difficulty in telling whether it is to the right, left, in front or behind. Suppose the source of sound to be directly in front. Then, assuming of course that there is no wind, the sound waves will reach both ears at the same instant, equalizing the amount of sound recorded by each ear. But if the source of sound is at a flank of the observer, the paths over which the sound waves must travel to reach the ears would be of different lengths, so that the sound waves would reach the ear on that side before reaching the ear on the farther side. Hence, sound waves reaching both ears at the same instant would be *out of phase;* that is, the crest of the wave would reach one ear slightly in advance of the other.

As the ears of a human being are only a few inches apart, this difference in phase is very slight. Let us imagine, then, that we have two ears, placed four feet apart. Then, if the source of sound is at a flank, there is a much greater difference in the length of the sound paths, and therefore a corresponding increase in the difference in phase. This would make it much easier to determine the position of the source of sound. That is exactly the result accomplished by the sound locator. In the place of ears, four large, conical horns are placed on pivoted arms, A and B, Fig. 2. The two horns, C and D, on the horizontal arm, are spaced four feet apart and connected by means of rubber tubing to a headset having rubber ear pieces. The other two horns, E and F, on the vertical arm, are arranged in the same manner.

Three observers, one for each pair of horns and one to read the direction dials (these will be explained later), are required to operate the instrument. A plane approaches. The locator is pointed in the general direction of the sound. The observer using the horizontal pair of horns, dons his headset. If the sound is louder in his right than in his left ear, he knows that the locator is pointed too far to the left. Moving it alternately right and left, he finds a point at which the sound seems to be the same in both ears. He then knows that the source of sound is directly in front of him, and calls, "on target." Holding his horns stationary, he notes that the sound is increasing in volume in his left ear, hence the plane is moving toward his left. Moving the horns when necessary, he strives to keep the sound centered. In the same manner, the second observer located the position of the plane with the horns on the vertical bar, thereby getting the location of the plane in relation to its elevation. These horns on the vertical bar swing horizontally with every movement of the horizontal bar, so are always pointing toward the plane.

Mounted on the pivot of the horizontal bar, and remaining always stationary, is a circular dial divided around its circumference into 360°. The zero mark is alway pointed to the north. When the horizontal bar is moved a pointer on it indicates the number of degrees from zero, or north, the horns are pointing. A second dial, consisting of half a circle and marked off in divisions of 0° to 180°, is used in conjunction with the horns on the vertical bar to indicate the elevation of the plane; that is, the angle formed with the ground by a straight line to the plane. Thus, if the plane were directly overhead the pointer would indicate 90° on the vertical dial. Corresponding dials on the searchlight are adjusted to coincide with these.

The third observer reads the dials on the locator. Both listeners having reported "on target," the third man reads, let us say, 20° on the horizontal and 75° on the vertical dial. These numbers he phones or calls to the man at the control wheel of the searchlight, who at once sets the light at 20° from zero and elevates it 75°. Were the sound locator absolutely accurate, the beam of the searchlight would now fall directly upon the plane. There are, however, always some variations, due to wind and speed of the plane, but this method is far more accurate than the ear alone.

Time Saving Wire Tables

This table when used to ascertain just how much wire is necessary to wind certain coils of various lengths and widths with various sizes and kinds of wire will be found to be extremely valuable.

Size B & S Gauge	Enameled	Turns per Inch: Single Cotton Covered	Double Cotton Covered	Single Silk Covered	Double Silk Cover
20	29	25	23	27	26
21	32	28	26	31	29
22	36	31	28	34	32
23	41	34	31	38	36
24	43	37	33	42	39
25	51	41	36	47	43
26	56	43	39	52	46
27	64	49	42	57	52
28	71	54	45	63	56
29	79	58	48	70	62
30	88	64	56	77	67
31	100	69	57	85	72
32	112	75	60	93	78
33	134	81	64	102	84
34	140	87	66	112	91
35	156	94	73	120	97
36	173	101	78	130	104
37	201	108	84	141	110
38	225	115	89	151	117
39	256	122	95	163	123
40	288	130	102	179	129

In calculating the size of tuning coils, loose couplers, choke coils, electro-magnets, etc., one of the most important factors which has always to be known, is the turns per inch of the various forms of insulated copper magnet wire, and the accompanying tables should prove of extreme value to all readers who are anxious to design or calculate any such windings as these.

For average calculations the turns of magnet wire per square inch of cross section of winding, such as in electro-magnets, solenoids, etc., can be found by *squaring* the turns per inch as given in the table at the left. The table below is a very useful one and one which has not been publisht before, so far as we know. This table gives the feet of wire per inch of winding, for cores of various diameters.

Contributed by E. T. JONES.

Turns per Inch	Feet of Wire: 20	24	28	32	36	40	45	50	55	60	65	70	75	80	90	100	Diam. of Core
	5	6	7	8	9	10	11	12	14	15	16	18	19	20	22	25	1
	7	8	9	10	12	13	15	17	18	20	22	23	25	27	30	33	1¼
	8	9	11	12	14	16	18	20	22	24	26	26	30	32	36	40	1½
	9	11	13	15	17	18	21	23	25	27	29	31	33	36	41	46	1¾
	11	13	15	17	19	21	24	26	29	31	34	37	39	42	47	52	2
	13	16	19	21	24	27	30	33	37	40	43	47	50	53	60	67	2½
	16	19	22	25	28	31	35	39	43	47	51	55	59	63	71	79	3
	19	22	26	29	33	37	41	46	50	55	59	64	69	73	82	92	3½
	21	25	29	33	38	42	47	52	67	63	68	73	79	84	94	105	4
	27	32	37	43	48	53	60	66	73	80	87	93	100	107	120	.....	5
	31	38	44	50	56	63	71	79	86	94	102	110	118	126	.....	.....	6
	37	44	51	59	66	75	85	92	101	110	119	128	138	.....	.....	.....	7
	43	51	60	69	77	86	96	107	118	129	139	150	.....	.....	.....	.....	8
	47	56	66	75	85	94	103	118	129	141	153	.....	.....	.....	.....	.....	9
	52	63	73	84	94	105	118	131	143	157	.....	.....	.....	.....	.....	.....	10

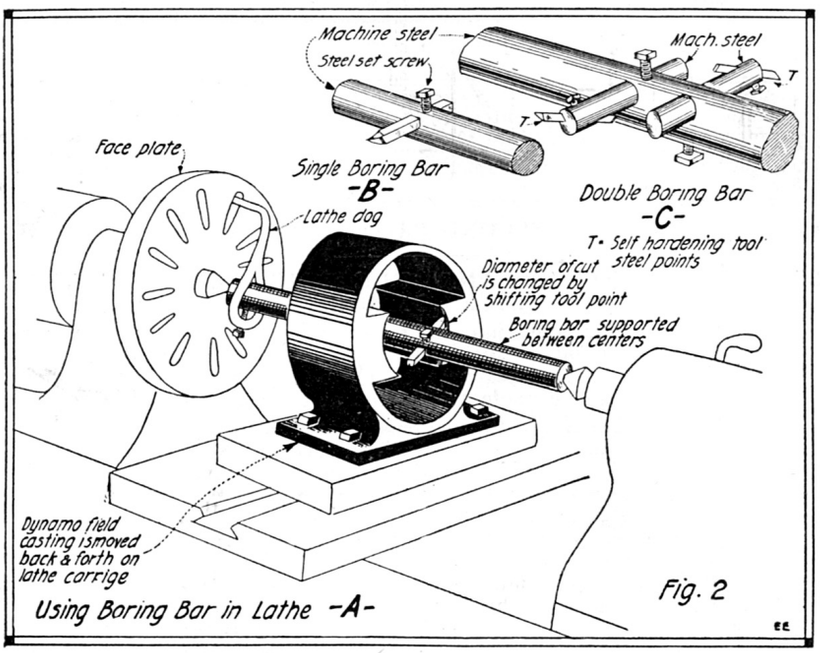
The Electrical Machinist

By H. WINFIELD SECOR

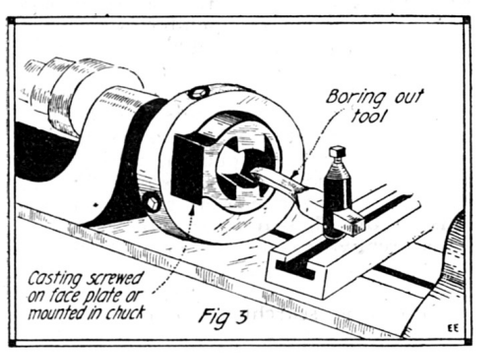
NO. 4 — MACHINING FIELD CASTINGS.

ONE of the principal problems met with in Electrical Machine work is the machining of motor and dynamo field castings and field poles. This paper deals with some of the more common methods of finishing up field castings, as well as separate pole-pieces. At Fig. 1 several interesting wrinkles are illustrated, which will save much time and labor. At A and B are shown two simple and effective ways of boring out the pole-faces of small dynamo or motor castings. In many small size machines, similar to these types, the cast iron or malleable iron members are left unfinished with respect to the inside pole-faces surrounding the armature.

However, it is very imperative that the air-gap be left very small in all dynamos and motors and never more so than in the small battery voltage machines. Therefore, it becomes necessary in order to realize the highest electrical efficiency from the machine (which is occasioned by minimizing the thickness of the air-gap between the field and armature) by accurately machining or boring out the pole-faces.



Boring Out Dynamo and Motor Field Castings With a Boring Bar, Rigged Up in the Lathe.

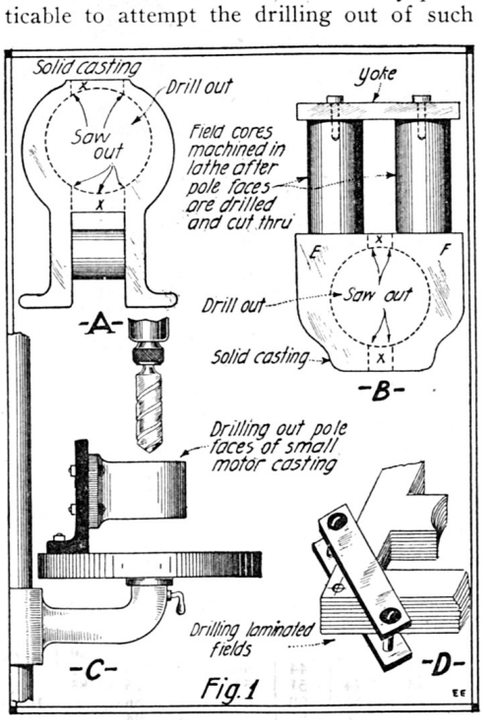


Mounting Field Castings on Face-Plate or Chuck of Lathe and Boring Out Pole-Pieces With Boring Out Tool.

Of course, the two pole-faces such as shown in the design at Fig. 1-A and 1-B have to be separated at the points marked XX, but it is best to cast this part of the frame in one continuous ring. If this is done and where the casting is drilled out or bored out on the lathe, it will be found much more rigid and suitable for carrying out this operation than if the pole-pieces are left open at the points XX. When the polar bore has been finished to the proper diameter then the sections XX in the casting can be cut away with a hack-saw and filed smooth. The casting shown at Fig. B is made in one piece, excepting the yoke. It is not necessary to machine the magnet cores, but if it is desired to turn them off in a lathe, this can be done after the polar bore has been either drilled or tooled out to the proper size, and the two pole-pieces E and F are cut apart at XX.

It is usual to mount small field castings on the carriage of a lathe or else on the lathe bed in any way convenient, so that the casting is held solidly—but as shown at Fig. 1-C such castings can also be held for drilling vertically on a right angle bracket on a drill press table. Of course, the point to watch in any of these operations is, primarily, to see that the polar bore *is made parallel with the base* and bearing supports. The base of the motor is usually machined on a *milling machine* or *shaper*, as nearly parallel as possible with the axis of the unfinished polar bore, and thus this becomes the controlling factor in aligning the casting for any further machine operations.

At Fig. 1-D a handy wrinkle is shown for drilling laminated sheet steel transformer or field cores, which involves the use of iron clamp members which are put under compression by means of bolts in the manner shown. It should be mentioned at this juncture that on small castings such as those described above, it is rarely practicable to attempt the drilling out of such

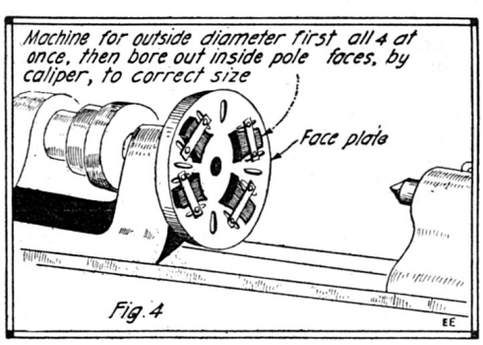


Tricks in Casting and Machining Dynamo and Motor Castings.

thin portions as the pole-pieces with a large drill, say of about 1¼ inches or greater diameter. The easiest and most sure way to do this is to drill around the outline of the polar bore, as laid out with dividers on the surface of the iron after it has been rubbed with chalk, with a small drill about ⅛ inch in diameter on small castings, and of greater diameter on larger castings.

The inner face of the pole-piece should then be carefully filed to the correct diameter and a smooth finish given with a file, using a coarse file for roughing out, and a fine file for finishing the surface. A half round file is best suited to this work.

Another very good method for boring out the pole-pieces in such small castings is to drill, say a one-half inch hole thru the center of the casting on the polar axis and then to mount the casting on a face-plate in the lathe; then with a boring out tool proceed to machine out the iron until it is of the proper diameter. The connecting parts of the casting at XX are then cut away with a hack-saw along the dotted lines as shown.



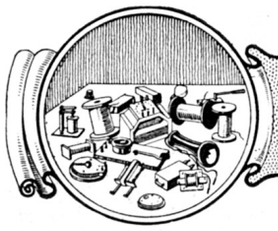
Machining Separate Pole-Pieces of Electrical Machinery. The Pole-Pieces May be Secured to a Face-Plate and "Turned" Inside and Out to the Correct Diameters.

USING THE BORING BAR FOR FIELD CASTINGS.

At Fig. 2 the application of the boring bar to the machining of dynamo and motor field castings is shown. This bar is usually made from a piece of steel either cold rolled or what is commonly known as *machinery steel* stock; this latter is a mild homogeneous grade of steel which can be readily worked. There are two kinds of boring bars in general use on light machine work, and these are shown at Fig. 2-B and 2-C, respectively.

That shown at B has one tool point inserted in the bar, while C has two revolving tool heads and carries two tool-steel cutting points. The single point boring bar is shown in operation turning out the polar bore of a two-pole field casting at Fig. 2-A. If the boring bar is to be made in the shop, it should have two center holes drilled accurately in either end, and in about the center a round hole of suitable

(*Continued on page* 1078)



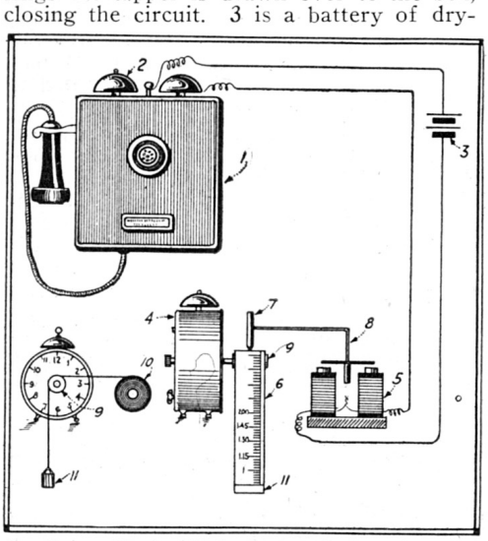
HOW-TO-MAKE-IT

This department will award the following monthly prizes: First Prize, $3.00; Second Prize, $2.00; Third Prize, $1.00.
The purpose of this department is to stimulate experimenters towards accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a prize of $3.00 is awarded; for the second best idea a $2.00 prize, and for the third best prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE, $3.00

A TELEPHONE "CALL RECORDER."

The parts used are as follows: 1 is an ordinary house telephone, or the gong box on the private phone. 2 is a breaker between the gong and tapper. When the bell rings the tapper is drawn over to the bell, closing the circuit. 3 is a battery of dry-



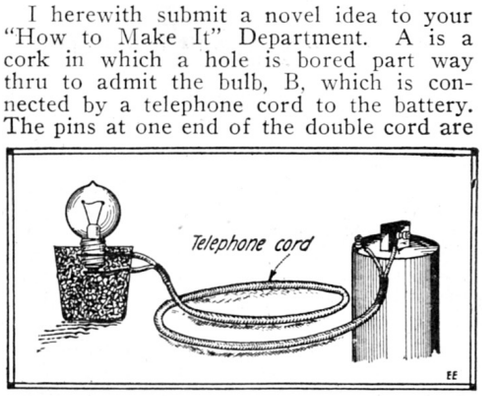
A Home-Made Telephone Call Recorder Which Anyone Can Construct From An Alarm Clock and a Telegraph Sounder, Together With Some Paper Tape.

cells. 4 is an alarm clock with the hands removed. 5 is a telegraphic sounder, or a vibrating bell adapted for the purpose. 6 is a paper tape, about one inch wide, passing over 9, a wooden spool or spindle. 7 is a soft pencil fastened to the sounder by wire No. 8. 10 is spindle with reserve tape on it. 11 is a weight to hold tape tightly to the spindle.

Contributed by HOWELL W. MILLER.

LAMP SOCKET FROM CORK.

I herewith submit a novel idea to your "How to Make It" Department. A is a cork in which a hole is bored part way thru to admit the bulb, B, which is connected by a telephone cord to the battery. The pins at one end of the double cord are



Why Worry About the High Cost of Lamp Sockets, When You Can Make a First Class One for Miniature Lamps by Cutting a Hole for the Lamp Base in an Ordinary Cork as Shown?

inserted, one at the bottom of the hole and the other at the side and a little higher. These make contact to the lamp base.

Contributed by AN EXPERIMENTER.

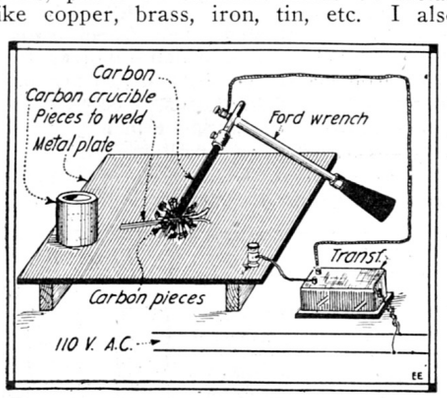
SECOND PRIZE, $2.00

WELDER AND ELECTRIC FURNACE COMBINED.

The most important factor in the construction of this welder and electric furnace is its cheapness, owing to the fact that it can be made from odds and ends.

The following materials are needed: A common Ford wrench, a ⅝ inch soft core carbon, plate of metal (copper, iron or galvanized iron sheeting), a small piece of plate carbon about 2x4 inches, or some carbon rods pounded into small bits. A piece of flexible heavy wire is used in connecting up the device. A complete diagram of how this is assembled is shown in the accompanying diagram. By using the transformer (several of which have been described in the previous numbers of the ELECTRICAL EXPERIMENTER), or by using a rheostat composed of water electrolyte or a coil of wire, the welder will work satisfactorily. The transformer used must be wound as a *welding transformer,* to give a low voltage, high amperage current. A transformer capable of giving fifty volts, twenty-five to thirty amperes A. C., at the secondary will work very well. The flexible wire running to the wrench can be either soldered or fastened by a fixt binding post.

In working it, I was able to weld nails, wires, plates of different kinds of metal, like copper, brass, iron, tin, etc. I also



Electric Welder and Furnace Combined—This Stunt Should Prove of Interest to Automobile Owners. As is Well Known, the Electric Arc Produces a Very Intense Heat and This Outfit if Properly Operated With a Suitable Size Transformer From the Alternating Current Supply Circuit, Will Work Very Smoothly and Satisfactorily.

mended small cracks or holes in motors, pulleys and vises, besides mending kitchen and household utensils that were made of metal, such as pots, pans, et cetera.

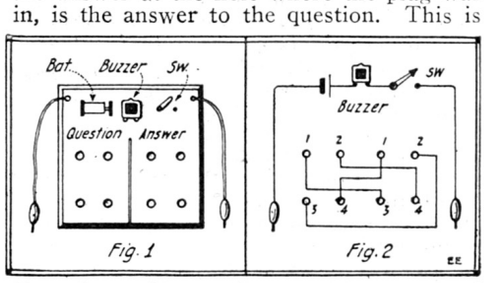
In using the welder for melting and casting small articles, I used a home-made carbon crucible. My crucible was two inches long, and one-half inch in diameter. I bored a 1-inch hole, 1⅝ inches deep, in the carbon rod. I melted and cast small articles out of tin, copper, brass, aluminum, etc. The moulds that I made for the melted metal to run into were made of plaster of Paris. Use heavy dark glasses when operating the outfit, because the light is hard on the eyes.

Contributed by LEONARD E. ARKE.

THIRD PRIZE, $1.00

AN ELECTRICAL QUESTION ANSWERER.

Here is a toy which will interest every one, besides being instructive. The illustration shows the idea so well that only a little description is necessary. The idea is that the person desiring to get the answer to one of the "questions," plugs in the hole at that question, and in the "Answer" section plugs in anywhere until the buzzer rings. This indicates the right answer and the answer at the hole where the plug was in, is the answer to the question. This is



Here is a Clever Electric "Question and Answer" Board Which will Provide Hours of Amusement to Both Young and Old During the Winter Evenings.

very interesting to children. The operation is easily understood. For a model, four questions were taken so as not to have a large and complicated wiring diagram. The diagram is shown in Fig. 2. But the wires to the answers are distributed haphazard, so there will be quite a lot of excitement finding the answer. A switch should be provided so as to cut the circuit when the answer is put away.

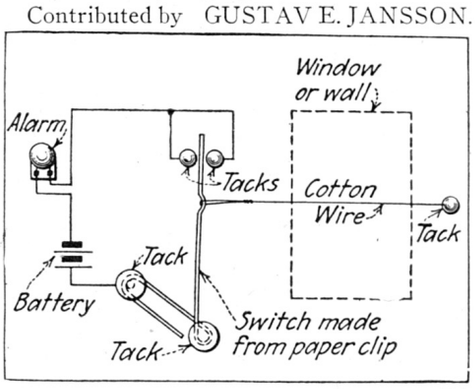
Contributed by PHILIP A. WALL.

FIRE AND BURGLAR ALARM.

The accompanying sketch shows a signal device made from a paper clip, some tacks and a piece of cotton wire. The thread stretched across a window will prevent anyone from entering as you will note that any movement of wire will close the contact.

The contact can also be used to give fire signals as it easily burns off, and thus makes contact, ringing the bell.

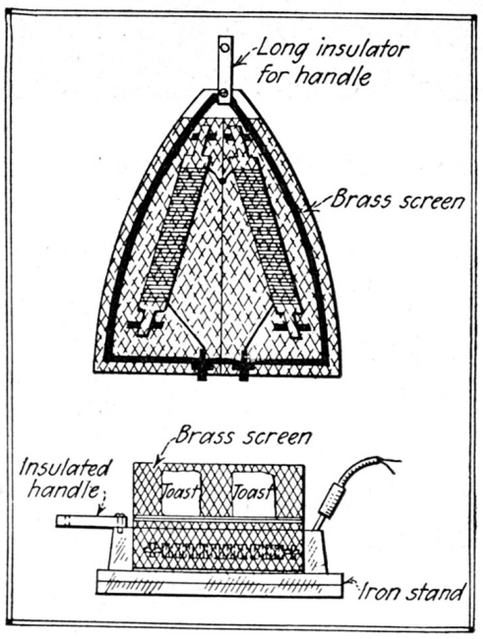
Contributed by GUSTAV E. JANSSON.



The Simplest Fire and Burglar Alarm We Have Yet Seen! It is Made From a Paper Clip and a Piece of Cotton Thread Which Holds One End of the Clip in Free Suspension. If the Thread is Run Into by a Burglar, the Contact is Closed, While a Fire will Burn the Thread, Thus Allowing the Contacts to Close.

A SIMPLY CONSTRUCTED ELECTRICAL STOVE.

An electrical stove can be made from a hot point iron in a few minutes. First



Home-Made Electric Toaster and Stove—an Electric Sad-Iron Forms the Basis of the Structure.

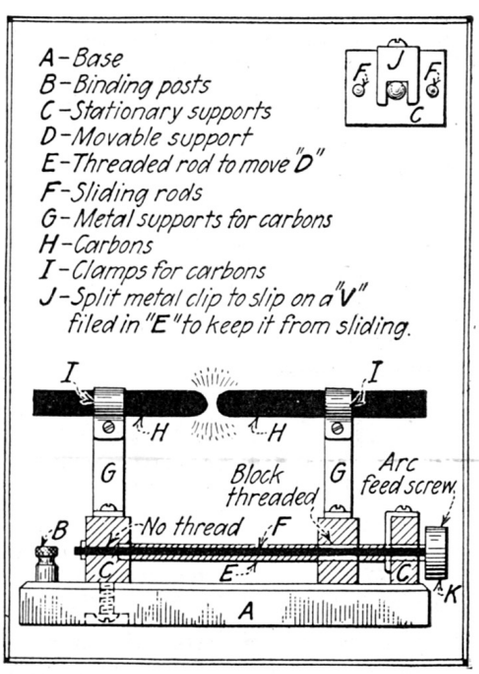
take the cover off and then remove the asbestos. From some brass screen fashion a grid of convenient shape and height so as to cover the iron. When one needs hot water, a flat-top screen is best, and for toast use the triangular shape, with a small place to hold bread. This can be replaced in sad iron in a few minutes.

Contributed by GEO. Y. MATSUMOTO.

AN EFFICIENT HAND-FEED ARC LAMP.

An efficient arc lamp can be easily constructed as per the accompanying sketch. No fixt dimensions are given because Amateur Mechanics usually change them to suit their material on hand anyway. I have operated one like this with a Nichrome wire resistance for some time, and it has given very satisfactory results. One carbon support only, D, is made movable by means of adjustment or feed screw K.

Contributed by ROBERT WOOD.



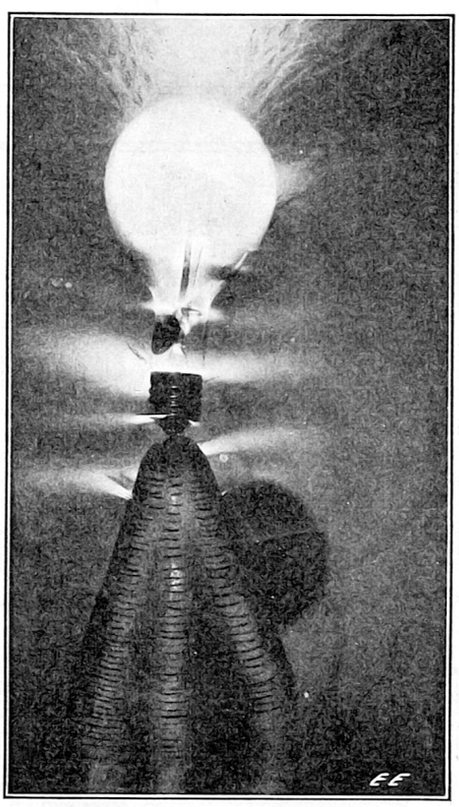
A Simple and Efficient Hand-Feed Arc Lamp.

LIGHTING 250 WATT LAMP ON 200,000 VOLT OUDIN COIL.

The photograph herewith shows a very interesting experiment conducted by the contributor, Edward E. Slyn, in which a 250 watt Mazda tungsten lamp was illuminated by placing the metal base in contact with the charged ball terminal of a powerful 200,000 volt Oudin coil.

Some of the most interesting and entrancing experiments in the whole realm of electricity can be conducted only by the use of this high-frequency air core transformer. Anyone possessing a wireless transmitter can easily rig up a high frequency coil which will produce sparks of quite an appreciable length. With a 1/4 K.W. step-up radio transformer, or with a 6 to 8 inch spark coil, it is possible to produce high frequency sparks 8 to 12 inches in length, when the condenser and spark gap in the circuit are properly attuned.

It might be interesting in this connection, to state that Dr. Tesla has said, the only difference between the *Oudin* coil and his own air-core high frequency transformer,

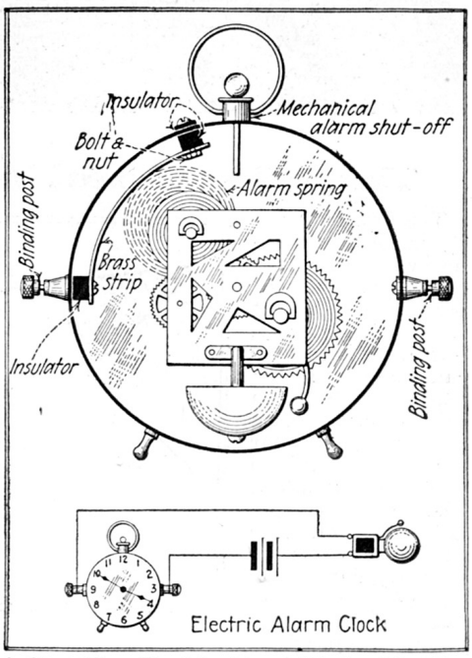


Many Spectacular and Beautiful Effects Are Obtainable When a Large Incandescent Lamp Is Lighted by an Oudin Coil. This Experiment Shows a 250 Watt Lamp Being Illuminated on a 200,000 Volt Oudin Coil by a Unipolar Discharge.

known as the *Tesla* coil, is that Oudin, while experimenting with some of Tesla's high frequency transformers, simply changed the connections around, and from this fact sprung what is known to the present electrical fraternity as the *Oudin coil,* which is ostensibly nothing more nor less than a Tesla transformer with one end of the secondary connected to the primary. Moreover, as Dr. Tesla had pointed out, his early experiments and notes, covered all such experiments as this, long before Oudin had happened to try it out. It is also of interest to mention that all of the kick-coil high frequency apparatus now on the market and used for the purpose of exciting so-called violet ray tubes, etc., including what is known as the *Collins-Sanchez* high frequency kick-coil set, are all primarily based on, and follow the specifications laid down by Dr. Tesla, in his high frequency coil apparatus, described and illustrated in the May, 1919, issue.

ELECTRIC ALARM CLOCK.

As the spring of the alarm clock expands, it makes contact with the brass strip, thus causing the electric bell circuit



A Sure-Fire Electric Alarm Clock. The Expanding Spring Closes the Electric Bell Circuit.

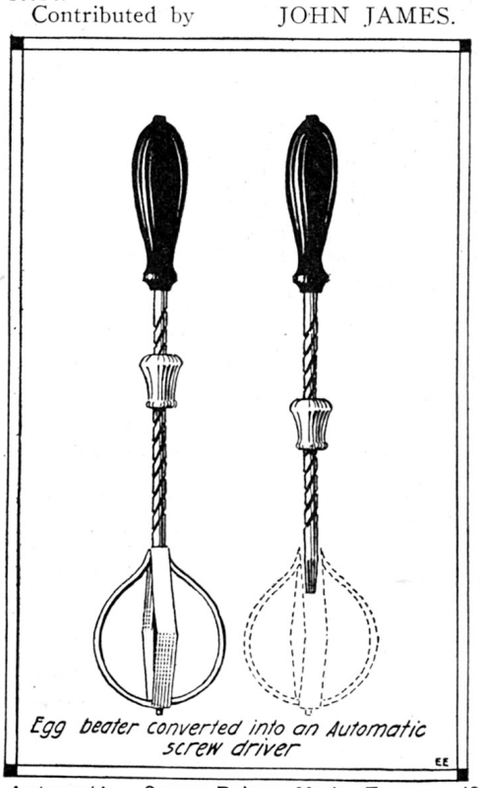
to be closed, or which can be used to operate the "alarm shocker" described sometime ago in the "E. E.," where the woodenhead sleeper is awakened by receiving a firm and sure electric shock thru two pieces of tinfoil laid under the sheet, and which connect to the secondary of a medical coil.

Contributed by IRVEN ELDRIDGE.

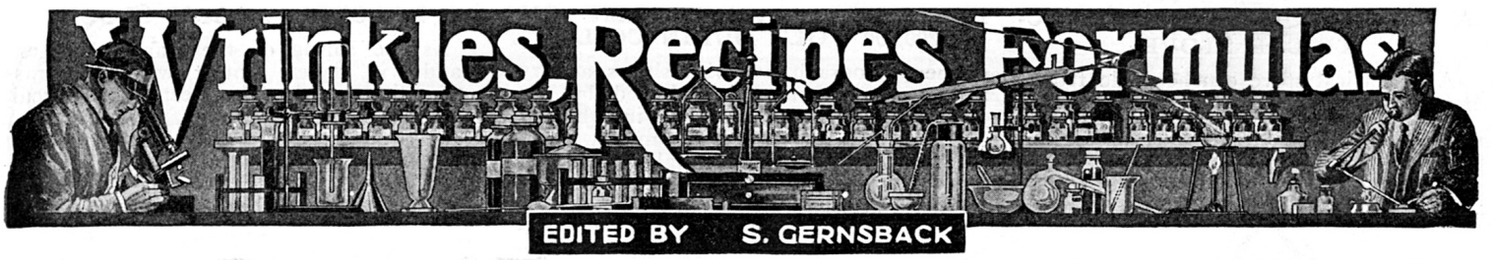
AUTOMATIC SCREW-DRIVER FOR TEN CENTS.

While working in the machine shop I had to insert a large number of screws. Not having an automatic screw-driver at hand I devised the one shown. Take off the bottom part and file to a point, that's all there is to making an automatic screw-driver out of an egg beater. You can get the egg-beater shown at any 5 and 10-cent store.

Contributed by JOHN JAMES.

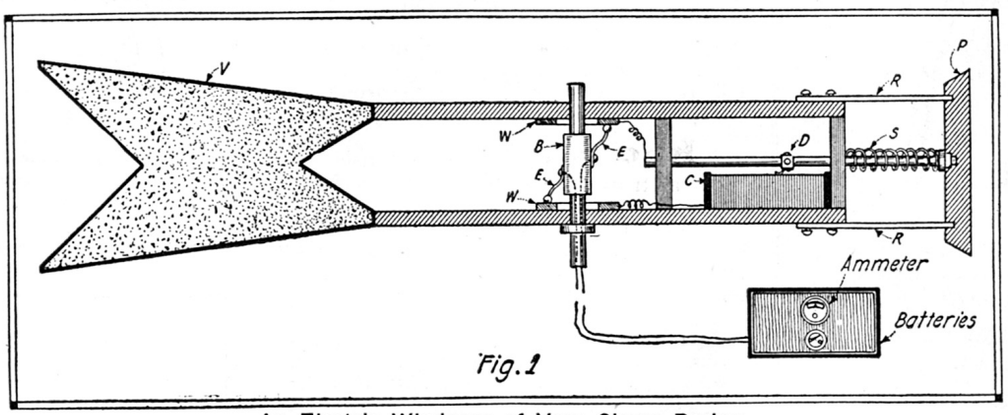


Automatic Screw-Driver Made From a 10 Cent Egg Beater.



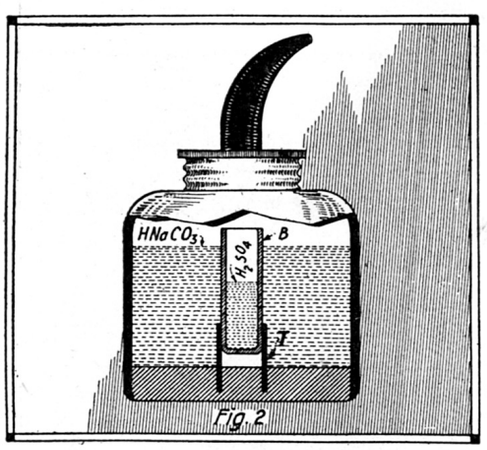
Three Successful Wrinkles

The first is a simply made anemometer (wind-gage), the construction of which is evident from the drawing, Fig. 1. P is a small pan about a foot in diameter; S is a coil spring which holds the pan as far out as the wind pressure will allow. The spring contact D presses on the resistance coil C, thus regulating the current. A small board B holds two spring contacts E, which press on the washers W. The wires run down the inside of the pipe X and are connected to an ammeter and switch. A paper scale may be fastened to the ammeter and the instrument calibrated by comparison with a standard instrument.



An Electric Windgage of Very Clever Design.

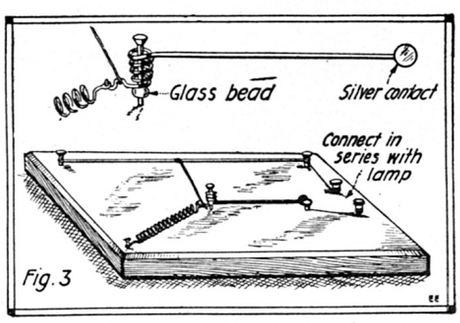
The *fire-extinguisher,* Fig. 2, can be easily made from a large oil can. A tube T is found, into which the bottle B may be inserted. This tube must be fastened to the bottom of the oil can in some manner. I used wax in the one I built. The bottle must be adjusted so that it will extend almost to the top of the can. The pressure is so great that all joints must be soldered. When ready to try the fire-extinguisher fill the can with a solution of sodium bicarbonate and the bottle with sulfuric acid, being careful not to mix them. Screw the top on tightly and the extinguisher is ready to use. When it is inverted the action of the acid on the sodium bi-carbonate generates carbon dioxide and the pressure of the gas forces the water out. This device will shoot at least 15 feet. If you wish some fun exchange a prepared can for somebody's oil can. After which you want to make yourself "scarce."



Fire Extinguisher of the Sulphuric Acid and Bicarbonate Type. Caution!

The construction of the *lamp flasher,* Fig. 3, requires no description. When the current passes thru the wire it expands slightly and allows the spring to separate the contacts C. As the instrument has quite a little resistance, more current must be used. This is for battery lamps only.

Contributed by
J. DURWARD MINER, JR.



Lamp Flasher of Simple Construction.

Analyzing Water

The following are a few tests which can be applied to drinking water. The apparatus can usually be found around the laboratory.

1—Clean carefully, dry, and weigh a porcelain evaporating dish.

Evaporate in this dish 1000 c.c. of water, over a water bath (which can be made from an old tin cover) and be sure that the last traces of moisture have been expelled, by heating two or three minutes after the dish appears to be dry. Weigh again and the difference between the first and second weighing, in centigrams, multiplied by ten is the number of milligrams per liter of total solids. Do not condemn the water solely for this reason unless it contains more than *four or five hundred milligrams of solids per liter.*

Apply hydrochloric acid to a portion of this residue, and if it effervesces, a carbonat is present, probably calcium.

2—To another sample of the water, add a few drops of silver nitrat solution. If a white precipitat, that is very evident, appears, the water probably contains sewerage, unless it is near a salt district, and it should be regarded with suspicion.

3—The presence of iron is determined by running hydrogen sulfid thru a sample of the water for a few minutes and if the water turns very brown, iron is probably present.

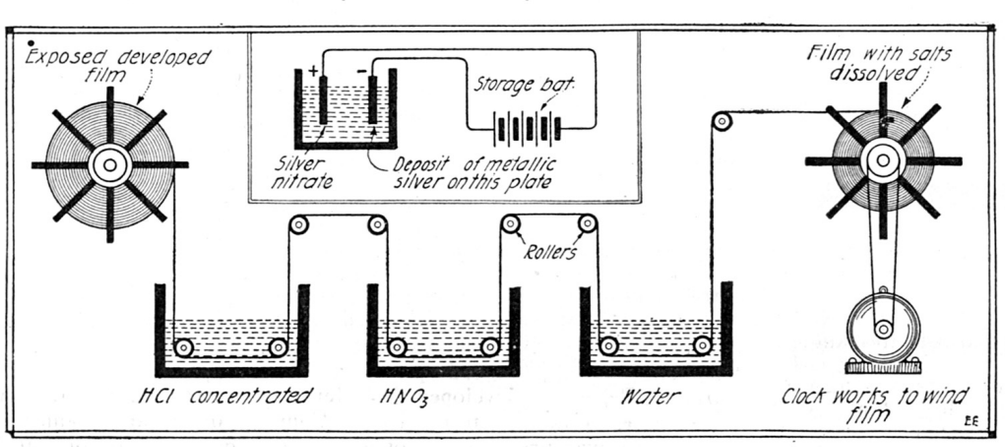
4—The amount of soap used before a permanent lather is formed on a sample of the water is a fairly good indicator of the hardness of the water.

5—Take half a test-tube of water and half a test-tube of distilled water. Add the same number of drops of potassium permanganat solution to each. Boil, and the difference in color is an estimate of the amount of vegetable matter present.

Contributed by PHILIP H. VIVIAN.

HOW TO RECOVER SILVER FROM FILMS.

The photographic film is first run thru hydrochloric acid. After the film is run thru the HCl very slowly it dips into the container containing the nitric acid, of course taking some of the HCl with it. These acids will dissolve any metals such as gold and platinum but leave silver in the form of a precipitate of silver chloride.



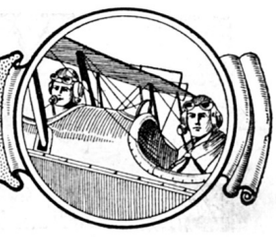
An Easy Way to Prospect "Pay-dirt" Right Here in Your Laboratory.

The acids are now mixed together very carefully, whence the silver salts will fall to the bottom of the container.

The solution is now filtered and the silver salts recovered from the filter paper and dissolved in an excess of ammonium hydroxide.

The solution thus obtained is now subjected to an electrolytic process whence the silver salts is deposited in its pure state, viz. metallic silver. Contributed by J. H. KRAUS.

RADIO DEPARTMENT

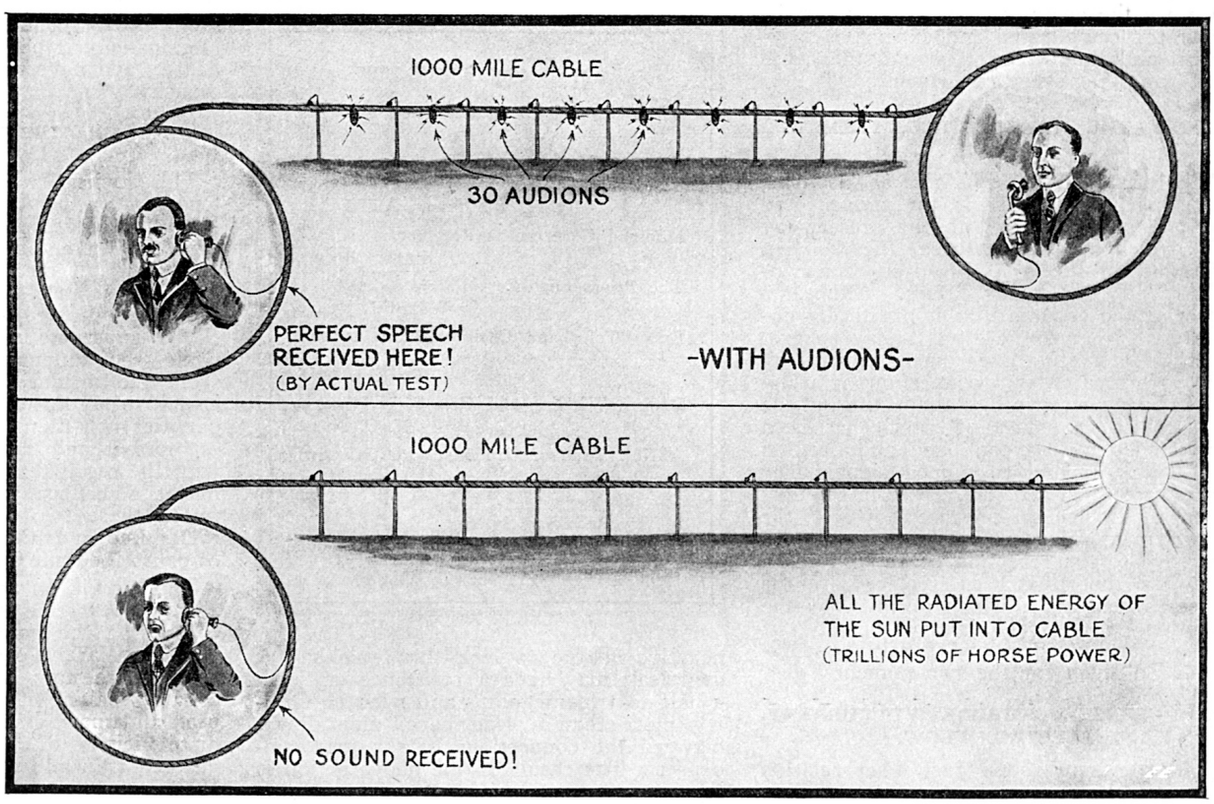


Audions Stronger Than Sun!

Thirty Audions Amplify Voice Stronger Than Sun's Total Radiated Energy

THE Audion, as we all know today has proved to be the real "dark horse" in the Radio game, if ever there was any! A simple little glass bulb containing a filament, grid and wing, which Dr. Lee de Forest started playing around with less than a score of years ago, and which at first looked more like a scientific or laboratory toy than anything else for many years, has rapidly come to the front, particularly during the progress of the World War, and now stands in the very front rank of Radio devices. It has not only threatened, but has actually surplanted in several instances the usual electro-dynamic and other standard forms of radio equipment, not only for receiving but for transmitting wireless telegraphic signals and telephonic speech.

Who Would Believe That 30 Audions Would Amplify the Human Voice So As To Give It Greater Strength For Transmitting Speech Over a Long Telephone Line, Than If All the Power Radiated By the Sun Could Be Applied in the Form of Telephone Waves To One End of the Circuit? It Has Been Computed In Connection With Actual Tests With This Number of Audions On a 1,000 Mile Circuit, That No Sound Would Be Heard at the Other End If All of the Power Radiated by the Sun Was Used in Place of the Audions. The Total Amplification Due to the 30 Audions Is Equal to 10^{30}.



Several hundred audion bulbs connected together in a bank enabled the U. S. Naval radio experts at Arlington, several years ago, to hurl the spoken word across the Atlantic from that station to the Eiffel tower radio station at Paris, France. The words spoken at the government high-power station in Arlington were also picked up in Honolulu, T. H., and practically every radio station of any size on the North American continent, as well as several South American stations picked up the radio-telephonic messages spoken into the microphone at Arlington. All of which goes to show what a wonderful device the present day development of the audion really is.

Glancing at the accompanying illustration we are astounded to learn that thirty audions, connected to a telephone cable 1,000 miles in length, are able to amplify perfectly the spoken word, and produce such a tremendous amplification of the voice that the total amplifying power resultant is greater than that which would be produced if all the power radiated by the sun could be applied in the form of a telephonic current!

The following report by a leading American telephone expert, and which report constitutes a portion of an affidavit regarding the applications of audion repeaters and amplifiers on long distance telephone cable, proves highly interesting; in fact, startling!

MR. O. B. BLACKWELL, BEING DULY SWORN, DEPOSES AND SAYS "that he is Transmission Development Engineer of the American Telephone and Telegraph Company having charge, among other things, of the development of telephone repeaters and amplifiers and has been engaged in telephone engineering for a period of thirteen years. That he is familiar with the history and development of telephone repeaters, and that to the best of his knowledge and belief there was no mechanical repeater capable of meeting the requirements for a telephone repeater or amplifier in actual telephone lines produced prior to the *Shreeve Repeater,* developed by Herbert E. Shreeve, of the Western Electric Company, which was first put into operation on a commercial line in August, 1904.

"That any repeater or amplifier which produced distortion of the speech currents is to that extent unfitted for use in tandem operation, because *the distortion is cumulative* in the successive repeaters; and that mechanical amplifiers generally and even the Shreeve repeater to some extent, produce distortion.

"That the *Audion amplifiers* used by the American Telephone and Telegraph Company are practically distortionless, and are commercially used in tandem operation in regular installations, and were so used in the first transcontinental line, which would have been impossible without the use of the tandem arrangement. That by actual trial over cable circuits approximately one thousand miles in length, it has been found that as many as *thirty* of these audion amplifiers can be connected in tandem and produce excellent speech at the receiving end of the line.

"That computation shows the attenuation of a cable circuit of this length to be so enormous that, if all the power radiated by the sun could be applied in the form of telephone waves to one end of the line without destruction of the apparatus, the energy received at the other end would be insufficient to produce audible speech without the use of amplifiers, whereas with the amplifiers used as above described, the relatively minute energy of ordinary telephone speech currents at the transmitting end produced speech in the receiver at the opposite end which was both loud and clear, and the amplification due to such a tandem arrangement of tubes being of the order of 10^{30} or 100,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000,000."

Vacuum Tube Circuits

By PIERRE H. BOUCHERON, Ensign, U. S. N. R. F.

Just What Each Circuit is Best Adapted for and What is Necessary to Make it Function

THERE is no question about it, the Vacuum Tube, usually abbreviated "VT," and sometimes called the Audion, the Electron Relay, the Vacuum Valve, the Oscillion, etc., is the most marvelous invention which has been added to the Radio art since Marconi's first "V" message flashed across the Atlantic back in 1898. It is at once capable of performing more electrical "stunts" than any other instrument of its kind, not only in radio science but in general electricity as well. The VT may be employed as a detector, amplifier, rectifier, or generator of high frequency oscillations, suitable for either undamped *Radio-telegraphy* or *Telephony*.

There are, of course, a multiplicity of circuits which will perform any of these conditions, some with better success than others, and all of which may be said to depend upon various operating conditions such as the characteristics of individual tubes, proper balancing of coupling circuits, wavelengths, etc. It is, therefore, the purpose of the accompanying diagrams to give some standard hook-ups which have been found generally successful, do not involve too complicated and expensive apparatus, and thus are not beyond the capability of the average experimenter.

NO. 1—THE TWO-ELECTRODE FLEMING VALVE.

The original *Fleming Valve* consisted of but two elements; that is, the *filament* and the *plate*, as compared to the present-day VT, which consists of three: the *filament*, the *plate* and the *grid*. Fig. 1 shows a two-electrode VT detector circuit. Altho this form of the vacuum tube is practically obsolete, it is given here as it may suggest possible interesting experiments which may be performed in this connection by using an ordinary electric light bulb, the outside surface of the glass of which has been surrounded by a metal band and used as the plate. Incoming damped signals may thus be rectified and intercepted in the telephones. In general practise, however, the two-element valve has not been found very sensitive to the reception of radio signals, and has therefore been replaced by the three-element tube, which permits, by the addition of the *grid control member*, of much more uniform and sensitive operation. So much for the two-element VT.

NO. 2—THREE-ELECTRODE "VT" CURRENT-ELECTRON FLOW.

This diagram shows just what relation the *electrons* emitted by the filament bear to the direction of the "B" battery plate current flow. To some experimenters it is not always quite clear why the electron flow should be directly opposite to the current flow. Before the advent of the electron theory it was arbitrarily assumed by investigators that the electric current traveled from *positive* to *negative*, but now it is found that the electric current is in reality a movement of negative electrons and *that they travel from the NEGATIVE to the POSITIVE side of a circuit.* Thus the direction of electronic flow is exactly *opposite* to the current flow, a fact that should always be borne in mind when experimenting with VT circuits.

NO. 3—GRAPHIC ACTION OF THE "VT" AS A DETECTOR.

Fig. 3 shows a graphic record of just what is assumed to happen in a VT detector circuit employing a grid condenser when the antenna picks up high frequency oscillations from a distant transmitter. Each wave train (A) causes the grid to increase its negative charge because some of the negative electrons are attracted to it and therefore the average potential of the grid falls in a manner shown in (B). The fact that the grid becomes negatively charged causes a partial or total stopping of the electron flow from filament to plate, thus causing a *decrease* in the plate current. At the end of the incoming wave train, however, this negative charge leaks thru the grid condenser and thus the plate current rises to its original strength as shown in (C). This is where the so-called "grid leak" makes its presence desirable by permitting the above mentioned negative charge to leak thru quickly. A grid leak may have a resistance of from a half to two megohms and need be nothing more than a lead pencil line drawn between the connections of the grid condenser. The result of the above action is that a *pulsating, unidirectional current* is imprest on the telephones, the character of which is similar to that shown in (D).

In February "Radio Amateur News"

The Armstrong Super-Autodyne
By H. W. Houck, A.M.I.R.E.

Modified Government Receptor.
By J. Stanley Brown

The Priess Loop Set—Part 3
By Walter J. Henry

Radio Telephone Communication to and from Trains.
By J. J. Graf

Banked Winding and How It Is Done.
By H. C. Silent

A New Type of Condenser for Selective Tuning.
By E. M. Sargent

A New Receiving System.
By Edward T. Jones

Junior Radio Section.

NO. 4—PLAIN DETECTOR CIRCUIT.

This circuit is the most commonly used and is usually the first one attempted by amateurs when first initiated into the mysteries and wonders of the VT. It is simple, inexpensive and will give excellent results for *damped* (spark) wave reception. The primary and secondary of the loose coupler may be wound for the efficient reception of waves ranging from 200 to 2,500 meters; the first wave for amateur work and the last one for reception of time signals from "NAA" (Arlington). The variable condenser V.C. may be of the standard .0005 mfd. maximum capacity, while the grid condenser should be preferably of the fixt type, about .0001 mfd. The grid leak as explained before may be made by inserting a piece of paper across the grid condenser contacts, upon which has been drawn a heavy lead pencil line; the heavier the line the lower the resistance, which latter should be about one megohm (one-million ohms). This lead pencil grid leak may also be placed in the circuit indicated by the dotted lines with equally good results. Try both ways.

As there are several types of bulbs each requiring different filament and plate voltages, care must be taken to secure the proper voltages for both. Some bulbs require but four volts for the filament or "A" battery, but the majority require six volts. The same applies to the plate or "B" batteries which range from 20 to 80 volts. The "A" battery current should be made variable by means of a small battery rheostat, while the "B" battery should also be variable, but preferably by means of a selector switch tapping individual cells. The "A" cells should be of the storage battery 40 to 60 ampere-hour type, 4 to 6 volts. The "B" cells should be small pocket flashlight batteries grouped together and conveniently boxed. The head telephones give best results when from two to three thousand ohms resistance in series, and the bridging condenser B. C. may be of the small fixt type similar to the grid condenser, and have approximately .0005 mfd. capacity.

NO. 5—THE HETERODYNE OR "BEAT" CIRCUIT.

This application of the VT is used extensively by the Army and Navy, particularly for the reception of undamped waves of high wave lengths. In this case an oscillating VT circuit is coupled to the antenna inductance and its capacity and inductance adjusted to generate oscillations of, let us assume in this case, 50,000 cycles; while the antenna oscillations received from the distant transmitter may correspond to 49,000 cycles. These two frequencies will therefore meet in the receiving circuit and interact upon each other with the result that there will be produced in the detecting system the difference between these two frequencies, i. e., 1,000 cycles, known as the "beat" note, which will of course be quite audible in the telephones.

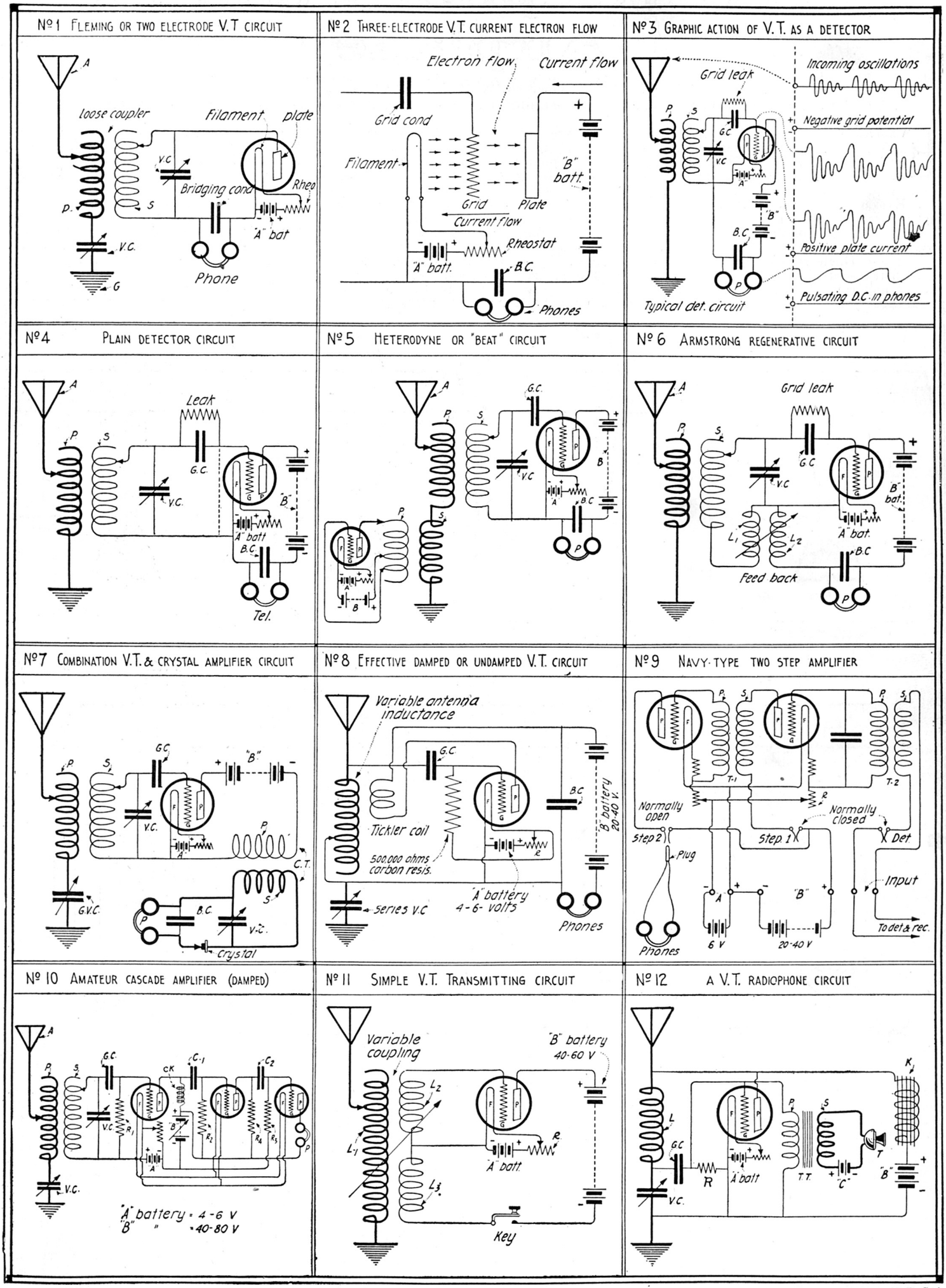
This circuit, on account of its flexibility, produces extreme selectivity and ease of controlling the note received in the telephones. Various forms of *heterodyne* reception are now being employed in this country making it possible to copy European undamped stations while in the immediate vicinity of a local high power undamped transmitter in constant operation. If long wave reception is attempted with this circuit, the inductances involved must be great enough to tune to long waves; that is, at a receiving range up to 20,000 meters, which will cover practically all undamped long distance stations. In this connection very inexpensive compact and efficient inductances which may be employed are the so-called "honeycomb" type, now in general use everywhere and which may be had to cover any desired wavelength.

NO. 6—THE REGENERATIVE "VT" CIRCUIT.

A simple and unique application of the amplifying action of the VT is used in this circuit which was devised by Major E. H. Armstrong, and modifications of which have been used extensively. The efficient performance of this circuit depends upon the proper degree of coupling between L1 and L2, which inductively couples the grid and plate circuit. It is

(*Continued on page* 1084)

Vacuum Tube Circuits



(Copyright, 1920, by E. P. Co.)

(Full explanation on opposite page.)

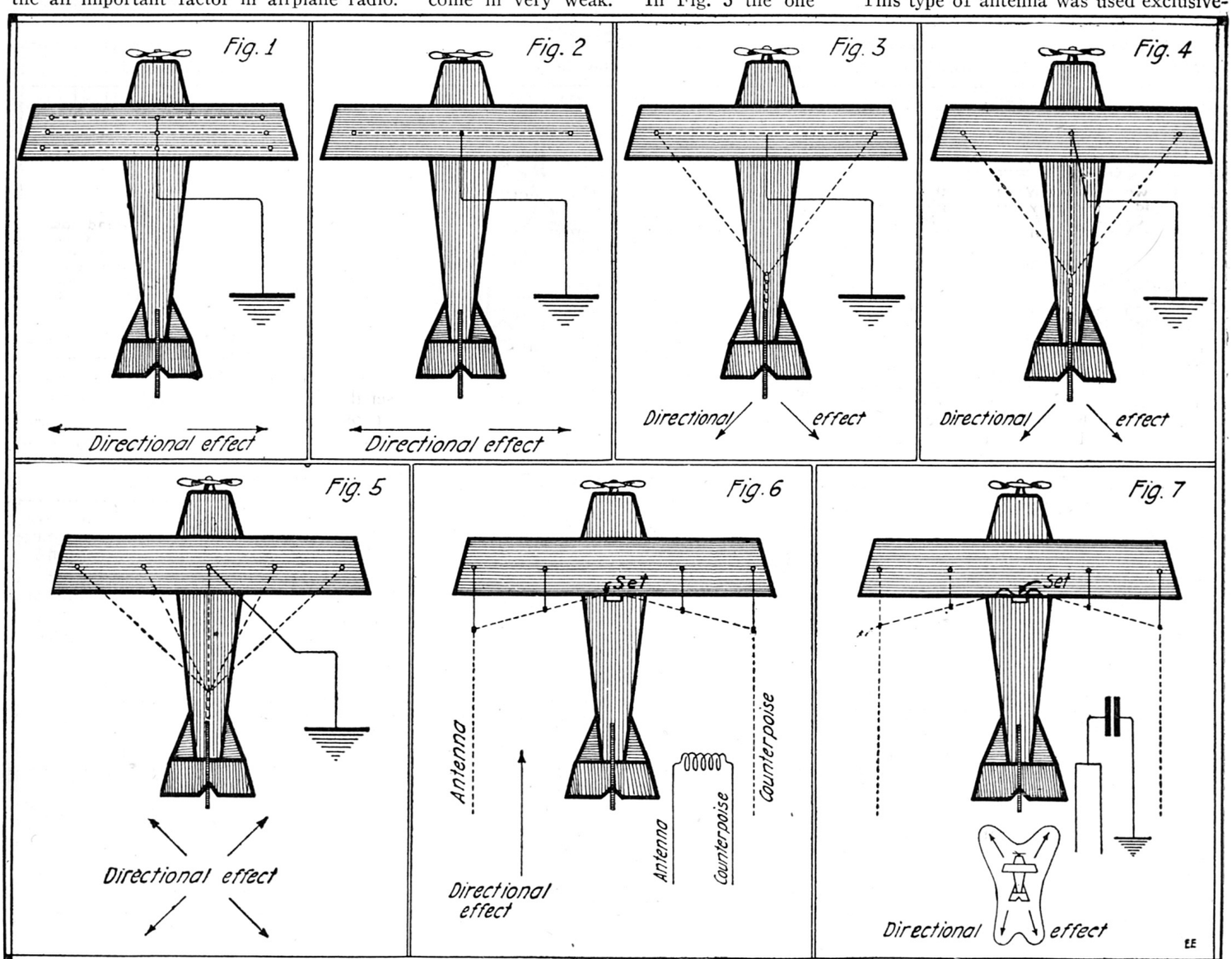
Radio Telephony and the Airplane

By WILLIAM C. MUNDT

LATE INSTRUCTOR, U. S. A. ADVANCED SCHOOL FOR RADIO TELEPHONE OFFICERS, GERSTNER FIELD, LA.

EX-LIEUTENANT DOYLE'S article on "Radio Problems in Aviation" in the October issue brought to mind the possibilities of the interest of the readers of the ELECTRICAL EXPERIMENTER to some information gleaned by the writer, not from books, but from actual experience at one of the large aviation fields.

As Lieut. Doyle stated, directional effect of both transmitted and received signals is the all important factor in airplane radio.



The Above Diagrams Showing Various Forms of Wireless Antennae for Use on Airplanes Have Been Tried Out in Actual Practice as the Author Points Out. These Should Prove Very Interesting to All of Us, Especially in the Directional Results Obtained.

It might be of interest to show by diagrams a few of the types of antenna tried out with their limitations. Figures 1 thru 5 are *fixt type* antennae, while 6 and 7 are *trailing-type*. The latter was finally adopted as the most practical for radio telephony on the airplane.

In all these types, the metal parts of the plane were bonded, and with the engine formed the *counterpoise* or ground.

Referring to Fig. 1 the three wires extended from the "cabane" struts on top of the upper wing. This type showed maximum radiation but since directional effect is desired to the rear it was undesirable. There were also very weak received signals by a plane equipt with a receiving set traveling alongside of transmitting plane, showing poor transmitting-range.

Fig. 2 is the same in type as 1, using however one wire. This reduced the capacity, but showed very little change in radiation; the directional effects were the same as 1, with the same limitations.

Figs. 3 and 4 both gave directional effect to the rear, but wavelength was so low as well as capacity that received signals would come in very weak. In Fig. 3 the one side of the triangle extended from "cabane" struts on upper wing to insulator attached to vertical stabilizer. The same with Fig. 4.

Fig. 5 used five wires extending backward as in Figs. 3 and 4 and gave the best radiation of any of the fixt type antennae but with the least positive directional effect.

We next took up the trailing-type antenna. Fig. 6 design comprised one wire as antenna and the other trailer as counterpoise, both wires extending about 200 feet to the rear. The directional effect was good but the wavelength and radiation was poor.

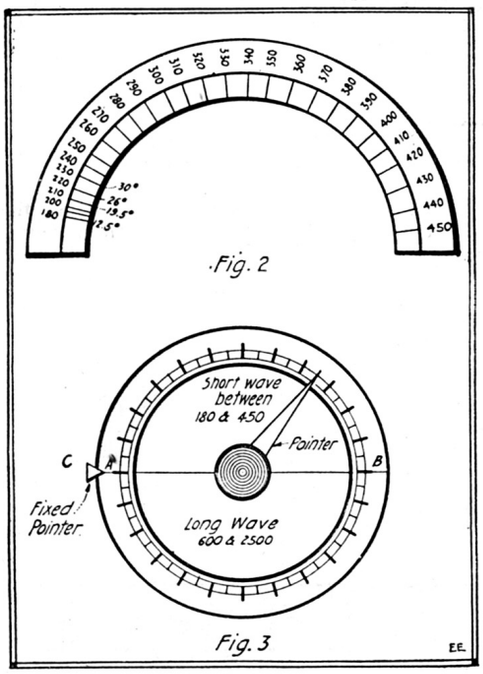
Fig. 7 illustrates the *Trailing-Type* antenna which was finally accepted as the best for training purposes, until a better one might be devised, tested-out and adopted. The directional effect was about perfect for inter-plane communication or "voice-controlled squadron formation flying." The long trailing wires were 200 feet of single strand No. 20 bare copper wire and were easily broken if caught in another plane, causing little trouble thereby.

This type of antenna was used exclusively for both transmitting and receiving but had this disadvantage. In a formation of say seven planes there would be one commander, with transmitting set, and the other six would be equipt with receivers only. All of them using the long trailers in changing positions they were continually breaking off parts of the antenna, causing the pilot more trouble in tuning-in the commander's signals.

The "DOUBLE-W" antenna was then evolved which is Fig. 2 in Lieutenant Doyle's article with this difference; the trailing wires are but 35 feet long, and

(Continued on page 1088)

Making a Wave Meter Direct Reading



This Shows How the Wave Length Scales Are Made and How They Are Applied to the Variable Condenser of the Wave Meter so as to Make it "Direct Reading."

LAY out a semi-circle of which the radius is the same as the semicircular scale on wave meter condenser. Next, consult the graph that accompanies the wave meter.

Suppose that curve for wave length is as in Fig. 1. If we take 180 meters as a starting point, we see that the corresponding value on the "degrees on condenser" scale is 12.5° (12½°). Then by means of a protractor locate the point on the laid-out semicircle at 12.5°. Opposite this point, mark "180 meters". In the same manner 190 meters will be found to have a corresponding value of 14.5°. By use of the protractor mark off point on the semicircle at 14.5°; this point is marked 190 meters, Continue this method of calibration until all the wave lengths have their relative positions marked off on the scale. The finished scale should resemble Fig. 2. Intermediate wave lengths like 295m. and 305m., etc., can be found and located, thus making a much finer calibration.

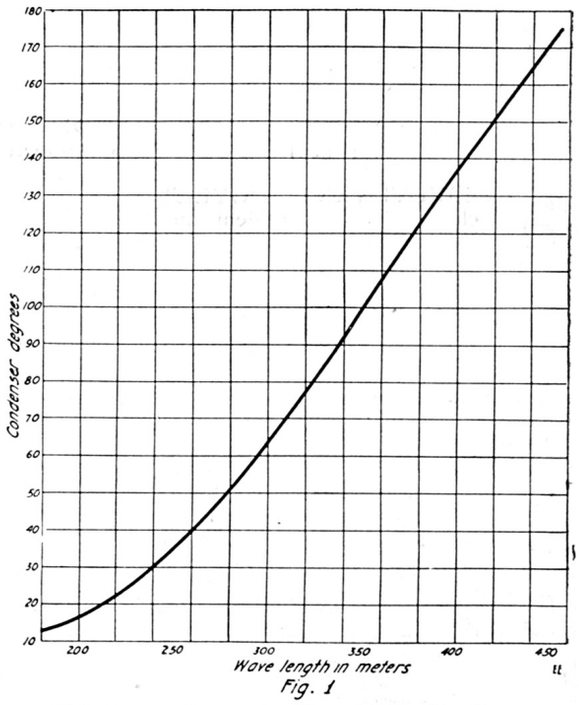
If the protractor is not handy, the points indicating the various wave lengths can be located by dividers.

The completed scale like Fig. 2 should be attached to the wave meter's condenser in such a way that its points corresponding to 0° and 180°, coincide exactly with the same marks on the condenser.

The amateur who uses this form of a wave meter will find it extremely handy and helpful where several wave lengths must be measured in a short time.

If the scale showing the wave lengths is made so that the degrees on the condenser can be read at the same time as the wave length, the accuracy of the calibration can readily be seen. By comparing the wave length read for a particular setting with that on the graph, a close check can be made.

Suppose that the wave meter has one inductance for short waves, and another for long. In such a case (if there is no binding posts on the top of the variable condenser) lay out a circle. Calibrate one-half of it for short waves and the other half for long waves. (See Fig. 3). Place the dial on the variable condenser as in Fig. 3.



This Graph Shows the Wave Meter Readings Plotted in Conjunction with the Successive Values of the Variable Condenser Scale. Instead of Reading the Wave Length Indirectly from Such a Chart, It Is Easier to Make Direct Reading W. L. Scales as Shown at Left.

In order to do the calibration quickly it would be well to tabulate the wave lengths and their corresponding values as follows:

W. L.	C.		W. L.	C.
180	12.5		320	77.5
190	14.5		330	85.
200	19.5		340	92.
210	16.5		350	99.
220	22.5		360	107.
230	26.		370	114.
240	30.		380	122.
260	39.5		390	130.
270	45.5		400	137.
280	51.		410	144.
290	57.5		420	151.
300	64.		430	158.
310	70.5		440	166.
			450	172.

If short waves lengths are to be read, set the dial so that its dividing diameter is opposite a stationary pointer (C) at (position A) which is the position when the 0° and 180° on the scales coincide. While the dial remains fixt in this position, short waves are read. If the inductance for long waves is used, rotate the dial until point B (Fig. 3) is opposite stationary pointer (C). Then read off long wave lengths.

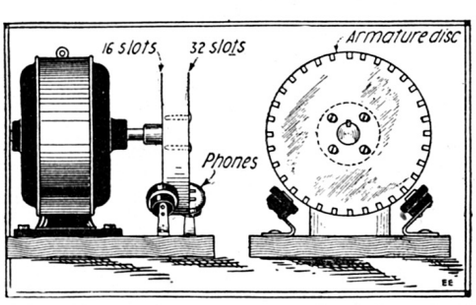
If binding posts are on the top of the condenser use two concentric calibrated semicircles to accomplish the above.

Contributed by WENDELL KING.

A Small Radio Frequency Alternator

This little machine was designed to meet the need of some device that would successfully imitate wireless signals, and keep on doing it without attention.

The materials required are a small motor, two old armature punchings about 3 inches in diameter and two 'phones; single or double pole, 75 or 1,000 ohms, it does not seem to make any difference in the way they work. The two punchings are mounted on the motor shaft about ¾-inch apart, or far enough not to allow both disks to affect the same 'phone. The disks should not have an equal number of slots, for if they were, both would yield the same tone.



The Above Illustration Shows a Simple and Very Efficient Design for a Small High Frequency Alternating Current Generator. This Machine Is an Excellent One for Supplying the Necessary High Frequency Current in Learning the Radio Code Signals.

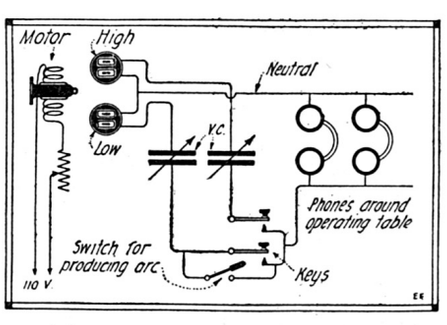
The 'phones should be so mounted as to have the revolving disks clear their pole pieces by about 1/32-inch. If it is desired the position of the 'phones can be made adjustable, thus allowing a variation in sound intensity without the use of a variable condenser.

The hook-up is shown in the drawing; this, of course, can be varied to suit individual tastes. The object of the two tones is to give practice in reading thru interference and to imitate arc stations. To produce the sound of an arc station one tone should be going all the time, the other should have a higher frequency and should be tuned in a little louder with the condensers, this louder circuit being broken up by the key. A speed regulator should be placed in series with the motor, so the speed can be adjusted to where the best note is heard in the 'phones.

A small machine similar to the one here described has been in use for teaching codes at a local high school and has given good service.

The necessary iron armature disks for building the rotor of this small high frequency alternator can be procured in most cases from some local electric repair shop. They can also be purchased from builders of small dynamos or motors or again, they can be cut out from some soft sheet iron or even from tin, but unless the tin is quite heavy several thicknesses of it should be used for each disk.

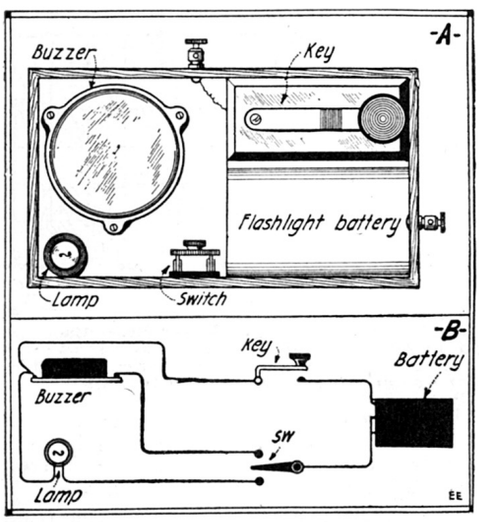
Contributed by R. H. OWEN.



Herewith Is the Hook-up for the High Frequency Telephone Generator Shown at the Left. This Scheme Has Been Used for Teaching Codes in a High School Radio Class and Should Prove Useful to Amateur and Professional Alike.

A POCKET "CODE" PRACTICE SET.

This set is completely enclosed in a box made of ⅛-inch cigar-box wood, and measuring 2¼x4¾x1⅜ inches, inside dimensions. Fig. 1, A, shows the arrangement of the key, battery, buzzer, lamp and switch in the box. The battery is one cell of a large-size flashlight battery. The lamp is 1.5 volts and is held in place by the connecting wires soldered to it. The key is mounted on a block of wood about ⅞ inch thick. The buzzer may be made to give a high note by gluing a piece of wood between the armature and contact spring. Fig. 1, B, shows connections. A lid may be made from ⅛ inch wood and fitted to the box. A copy of the codes is pasted on the inside of the lid. Binding posts are provided for connecting an outside battery in



Here's a Handy Pocket "Code" Learning Instrument Made from a Buzzer, Lamp, Switch, Key and Battery.

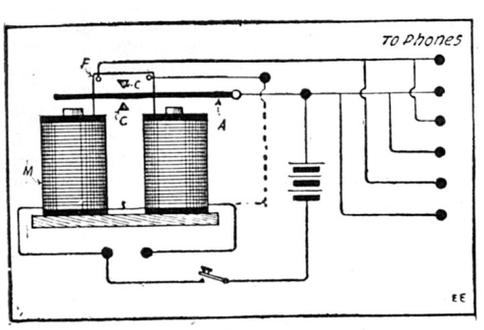
multiple with a flashlight battery so as to conserve its strength wherever possible.

Contributed by
HORACE R. BROKAW.

CONVERTING RELAY INTO A BUZZER.

When using a buzzer for radio code practice I found it desirable to adjust the buzzer to give a very high frequency note, and when looking around for something better I found that by a simple expedient an old relay could be made into a first-class buzzer.

All that is necessary to construct this buzzer is to connect one of the electro-mag-



Circuit Connections for Converting Relay Into a Buzzer for Radio or Other Purposes.

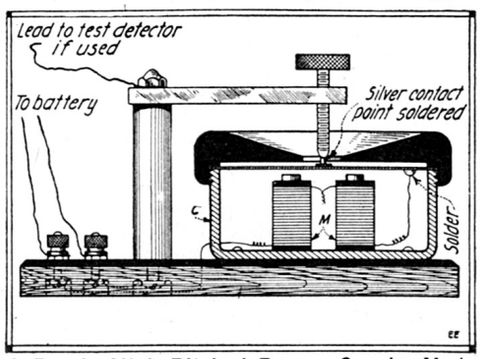
net terminals to the frame of the relay. If a temporary job is desired these connections may be made by means of the outside binding posts. It is also necessary to see that the uninsulated adjusting screw is on the side of the armature nearest the magnets. In other words, it is necessary to insulate the armature from the frame when the magnets "kill it."

By placing this buzzer on a base with a key and three pairs of binding posts for 'phones it makes a fine code practice set for embryo wireless operators.

Contributed by E. V. SHERMAN.

MAKING A BUZZER FROM A WATCHCASE RECEIVER.

This buzzer is made from a small watchcase telephone receiver, a piece of hard rubber for a base, and a piece of copper

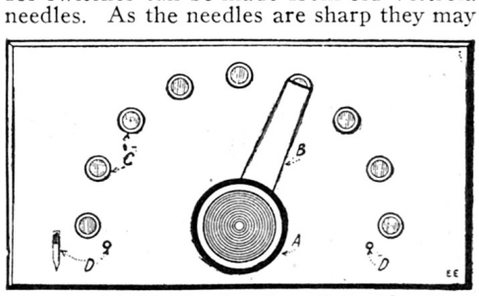


A Dandy High Pitched Buzzer Can be Made from a Watch Case Receiver.

tubing about two inches long, some copper wire of about the same length, and two 8-32 machine screws, one about two and one-half inches long. A hexagon nut is placed at the upper end, which may be used to attach a wire to, leading from the detector; the other screw is about one inch long and fitted with a hard rubber knob. This is put on top to prevent a shock. At the other end is a fine silver wire, which makes contact with the small silver disk soldered or riveted onto the diafram. However, the drawing is self-explanatory. This buzzer gives forth a sound like a real radio signal. Contributed by ROY HILER.

VICTROLA NEEDLES AS SWITCH STOPS.

The illustration herewith shows how pins for switches can be made from old Victrola needles. As the needles are sharp they may



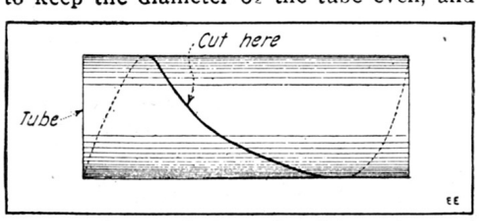
Discarded Victrola Needles Make Excellent Switch Stops if Used as Shown in the Illustration.

be easily driven in wood. For hard rubber or bakelite a small hole should be drilled and the needles driven in the hole.

Contributed by HUBERT CHIDDIX.

TO REDUCE DIMENSIONS OF PAPER TUBES.

A very successful way to reduce paper tubes, is to make a circular cut around the tube with a knife as shown in the illustration, and shrink it upon the form tightly on which it is to be mounted and mark where the tube overlaps itself, and then take it off the form and cut out the piece. Then take a piece of heavy paper and paint it with glue on one side, then put the tube back on the form and wrap it carefully with the paper, being careful to keep the diameter of the tube even, and

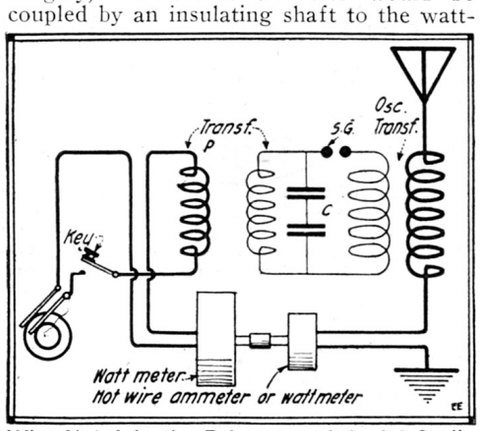


Scheme for Reducing the Dimensions of Paper Tubes. A Hint of Value to the Radio Amateur.

then set it away to dry. After the tube is dry it will be found to be as strong as ever. Contributed by HOWARD KING.

WHY NOT A RADIO "EFFICIENCY METER"?

Talking about "CONTESTS," WELL—I am about to spring one which I am sure if put to the test thru your magazine would create a lot of brain racking and exciting moments for the thousands of readers of the "E.E." I'll bet there will be a lot of valuable information spilled in the answering. I have studied the thing out myself, and as yet am a bit off on the correct solution as to its VALUE in practical work, the ratio between the transfer of energy in a radio transmitter not being any too well understood, I am at a loss to arrive at a decisive end. It may lead up to something good—as *two heads* are better than *one*. Here's the idea—mainly: (THE QUESTION WHETHER OR NOT IT IS POSSIBLE TO CONSTRUCT A METER WHICH WILL GIVE US A CORRECT READING IN PROFICIENCY) as here shown in the diagram—roughly, the hotwire ammeter would be coupled by an insulating shaft to the watt-



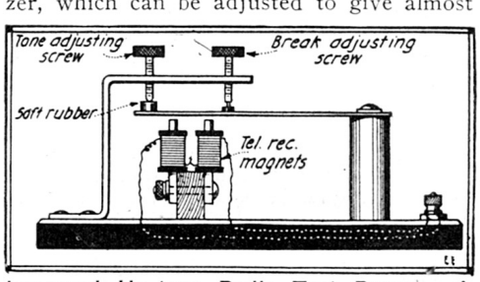
Why Not Join the Primary and Aerial Oscillating Circuit Meters Together, and Produce a Direct Reading "Efficiency" Meter?

meter—one bucking the other in such a way that a true reading of the efficiency of transferred energy from the *input of the transformer* to that of the *output (into the antenna)*. If seem as tho such a meter, if correctly proportioned could be built, as it is seen that if the set was overloaded the radiation would not be as great, therefore, the meter would show as the power was reduced; with more radiation given to the open circuit, then a greater efficiency would be indicated thru the meter. I am sure that this will create a lot of interest. Let's hear from the radio experts.

Contributed by E. T. JONES.

AN IMPROVED HY-TONE RADIO BUZZER.

A very satisfactory high frequency buzzer, which can be adjusted to give almost



Improved Hy-tone Radio Test Buzzer. A Very High Pitched Note Can be Obtained by Making the Armature of Spring Steel.

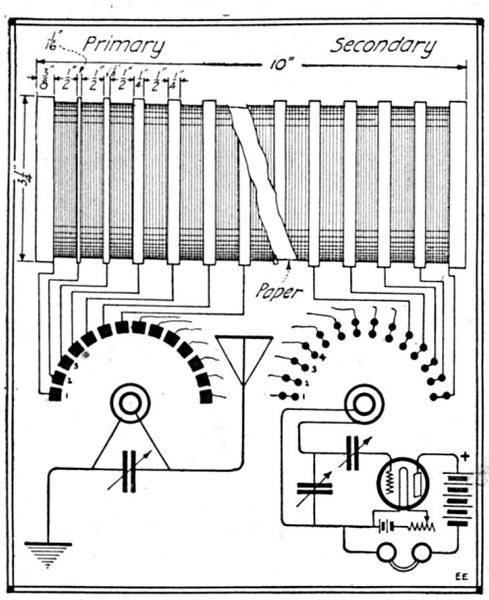
any tone and which can be made either very loud or very weak, can be easily constructed as delineated by the accompanying diagram. The coils are connected as in all standard buzzers. If deemed advisable, three posts may be connected in order to make two ready at all times to connect across the break. One of the wires is connected to the vibrator and the other to the binding post. Another wire connects the binding post with the brass "L" arm, which supports the adjusting screws. This post and the wire from the vibrator are the ones which connect to the break.

Contributed by ROBERT W. HART.

An Improved Loose Coupler

By FRANK H. BROOME, B. Sc.

MOST amateurs usually have trouble with the sliding secondary of their loose couplers, especially if they are home-made. When the coupler is mounted in a cabinet, this trouble is multiplied by the necessity of gears, pulleys, levers or other means of moving the secondary. The coupler described below has no moving secondary and will not only give the range of coupling that the common type of coupler will give but also variometer coupling, in that it is possible to reverse the windings with respect to each other.



An Interesting Type of Loose-Coupler in Which the Secondary Winding is Wound Over the Primary Winding and by the Clever Design of the Switches, the Coupling Can be Changed Without Moving Either of the Windings.

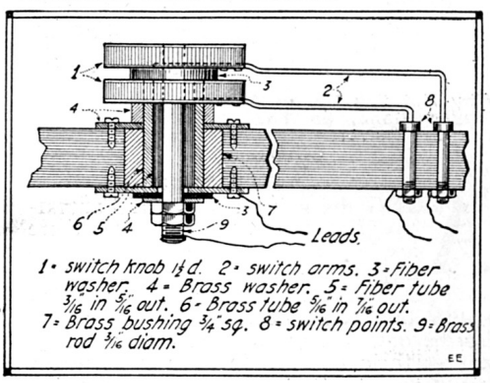
Only one tube is needed, that being about 3¼ inches in diameter and ten inches long. Starting ⅜ inch from one end of the tube, wind No. 26 B. & S., S. C. C. magnet wire for a length of ½ inch, take off a tap, leave a space of 1/16 inch and wind another ½ inch of wire, take off a second tap, leave ⅛ inch and wind a third ½ inch of wire, take off a third tap. Leave a space of ¼ inch here and wind the rest of the tube with ½-inch widths of wire with ¼ inch between each, taking off taps at each space.

Now shellac the tube and wrap on five thicknesses of good stout paper and shellac again. The primary is then wound on the tube in the same manner as the secondary but using No. 22 B. & S., S. C. C. magnet wire. The secondary taps are taken thru the inside of the tube and the primary taps are taken off the outside.

The secret of the loose coupling of this coupler is in the switches. Two 14-point switches are required with two switch arms on each, insulated from each other. The ends and taps of both primary and secondary are brought out to the points of the two switches respectively, in the same order, the right end of both primary and secondary windings being on point No. 1. These points must be large enough for both switch arms to make contact on them or else two small points used for each point. This type of switch is used on some variometer couplers and its design is left to the maker, altho the principle of it is shown in the accompanying sketch.

The inside switch arm is connected to the aerial and the outside one to the ground —primary winding. The two secondary switches are connected to the secondary apparatus in the same manner as the secondary terminals of any loose coupler.

To tune with this coupler, have the primary ground switch on the first point and adjust the aerial switch until enough inductance is in the primary circuit. Have the outside switch of the secondary on point No. 1 and adjust the inside switch until signals are clear and then move the two secondary switches together, keeping the same amount of wire in the secondary circuit. The two primary switches may also be moved together to change the coupling. By having the outside switch to the right of the inside switch on the primary and the *outside* switch to the left of the inside switch on the secondary, or vice versa, variometer effect is obtained.



Details of the Double-Pole Switch Used on the Loose-Coupler Here Described and Which Varies the Coupling by Connecting in Different Sections of the Windings.

As no tens and unit switches are used on this coupler, fine adjustment will have to be obtained by means of variable condensers across primary and secondary windings.

Details are given in the diagram, the primary switch having long switch points on the primary and two small points on the secondary.

The coupler may be either mounted in the receiving cabinet, in a separate cabinet or merely with ends and a front panel for the switches.

Getting Together on the Antenna

By E. T. JONES

SINCE the received current generally figures out something like three-trillionths of the radiated energy, there certainly must be room for improvement in connection with the receiving circuits and apparatus. It is the object of this article to point out as many features as will bring about in part or in full these requirements; if not now, probably in the near future.

The conservation of the received power is in fact more important than the radiated energy, as it is infinitesimally small and very easily wasted. Absolute connections, well soldered, and very low resistance wiring (high frequency resistance), induction in neighboring conductors, and an article dealing with the most efficient type of receiving aërial to be used are exceptionally scarce and I do think that it will be well read and put to practical use, especially among the Amateurs who are looking for economy and at the same time efficiency—with a capital E.

Everyone is aware of the fact that a good *sending* antenna is often a poor *receiving* antenna. Every antenna radiates energy to a greater or less degree. The energy in this case (receiving) is put into it by an electric wave (sent out from some other distant set) striking it; this energy is to be dissipated in some way, for example in a coupled circuit to create a telephonic sound, as we try to do *purely* in receiving. It will be noted that I state that the energy is to be used *purely* in some particular way. But a vibrating antenna tends to do both these things at once. Since the degree to which an antenna radiates can be controlled, and since we desire an antenna for reception which transfers as much as possible of the received energy over into the detector circuit, we must possess a type which radiates very little. Such an antenna of low vertical height and long horizontal length as described is recommended. Another advantage of long low antennæ for reception is that they intercept more wave front of the incoming wave, thereby being able to draw more energy and that practically *most of the long distance reception is done on those waves which are near the earth's surface.*

This antenna described below was but 20 feet high on one end and 6 feet on the other, being 120 feet long, and as will be noticed I received the same strength of signals on this antenna as was had with a former antenna, 70 feet high at one end and 25 feet at the farthest end, two phosphor bronze wires 200 feet long.

The antenna is composed of six strands of No. 24 D.C.C. magnet wire (with the insulation on), each strand being 120 feet long. They were first measured and then twisted together; further means of holding them together was furnished by wrapping a small piece of the same wire around the six lengths about every 5 feet, for the full length. The wire did not have any other metallic connection than that furnished at both ends; this was accomplished by first cleaning the insulation from each wire and then soldering the six together.

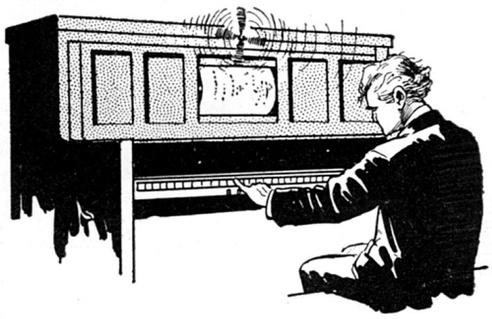
Since Radio Engineers have endorsed the winding of receiving transformers with *Litzendraht* or stranded cable to overcome the high frequency resistance and thereby get more energy to transfer to the detector circuit, why not begin with the antenna to overcome this fault, as I have done by making a Litzendraht antenna? This is given the most credit for the exceptional results obtained under tests.

For comparison sake, I had an antenna composed of the following: two phosphor bronze wires 200 feet long (fan shaped) stretched from a 70-foot pole declining to a fence 200 feet away which was about 25 feet high, (the break insulator at that end was so arranged as to allow the end of the aërial wire to be that distance from the ground, the remainder of the stretch being taken up with rope, down to a height of 6 feet). With this antenna I received a signal of 40 (audibility) from Swan Island which is exactly 900 miles from New Orleans. Owing to the fact that a severe storm blew my poles down, I was out of commission for about two weeks, at the end of which time I struck on the idea of using some No. 24 D.C.C. wire (which was all I had), in fact this was the main reason for using same, and naturally it required quite a few strands to give the desired tensile strength for that length (120 feet). Upon completion, this one wire

(*Continued on page* 1089)

What To Invent

By JAY G. HOBSON



Why Not Rig Up an Automatic Fan to the Player Piano, So That in Warm Weather You Get Refreshed As Well As Inspired and Entertained.

AMONG the many readers of ELECTRICAL EXPERIMENTER magazine there are no doubt thousands mechanically inclined who would appreciate suggestions of practical inventions so that they could work out the mechanical details, obtain a patent and either sell or market their finished device for whatever remuneration they could obtain. In order to assist those desiring information along the above line the writer will endeavor to give one or more new and original ideas each month in this department.

The first idea that comes to mind was suggested the other day by observing a friend pumping a player piano in a very hot room. The perspiration caused by this exertion was very much in evidence. The operator could not keep cool and enjoy the music while playing the instrument. To overcome this annoyance my mind pictured a small fan directly over the spool box, where the music roll is secured. A fan so constructed that it would run when the player was operated and remain idle when no music was played. (See Fig. 1.)

A fan made to run from the vacuum that produces the player piano music. A small device of this nature if compactly made and reasonably priced would sell to practically all player piano owners. The manufacturers would probably install one on each instrument leaving the factory, for the added service it would render their customers. There are hundreds of thousands of player pianos already in use and American manufacturers are turning out over two hundred thousand yearly. The market for a successful invention of this kind is very large and the inventor who first brings forth one that is satisfactory should reap considerable money from it.

While reading the morning paper I ran across a little bit of news relating to the theft of milk in the bottles that is placed upon the house steps each morning by the hasty milkman. The item told of eight or ten places where milk had been stolen the morning before. The loss of milk at fifteen cents a quart soon amounts to a large figure. Finishing the news note I pictured a device that would prevent this loss and at the same time assure the housewife the milk would remain free from contamination until ready for use. The device would be so constructed from metal that it would hold one or more bottles securely. I have in mind a metal strip about one foot in length with "L" shaped under trackage to accommodate the neck of the bottle. It would be fastened to the door sufficiently high so the small children could not tamper with it. Two small holes would be bored thru the door thru which the automatic catch would lock the device after the milkman had placed the milk therein. Having the locking part inside the door would prevent the theft from the outside. An invention of this kind would meet with a hearty welcome at each home and sell by the thousands if made to sell at a popular price. Possibly the large milk companies would be glad to buy them and give them away as souvenirs to their customers. This article would not only be a money saver but a popular advertising novelty as well. (See Fig. 2.)

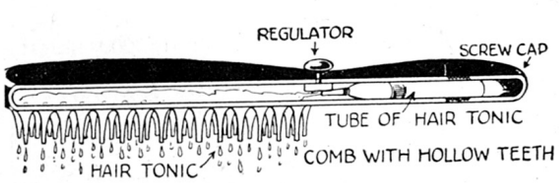
In the same paper I noticed the advertisement of a widely advertised hair tonic. The manufacturers instructed their customers to roll up a small piece of cotton, saturated in their remedy and draw this thru the parts in their hair, which would properly apply the liquid to the scalp. This method of application seemed very antiquated to me so I tried to picture or imagine a device in the form of a comb with little holes in the teeth leading back into the base where a long vial or tube-like arrangement would be connected with them and when filled with hair tonic would evenly and effectively apply the liquid to the hair and head. An invention of this description should find an immediate acceptance from some large hair tonic concern because it would assist the sale of their product. (See Fig. 3.)

During the cold season most everyone is troubled with their extremities suffering from lack of circulation. Their hands and feet are difficult to keep warm because they are the furthest from the source of heat and exposed to the rigor of winter. The hands particularly suffer on account of their inaction. Agents and salesmen who canvass from house to house taking their sample case with them must find it very hard to keep their hands warm because they must carry their wares by the handle of the case. This condition suggests a small device in the form of an electric battery, a resistance coil imbedded in the handle of the hand bag, a wire connection between them and a little switch secured near the lock of the case.

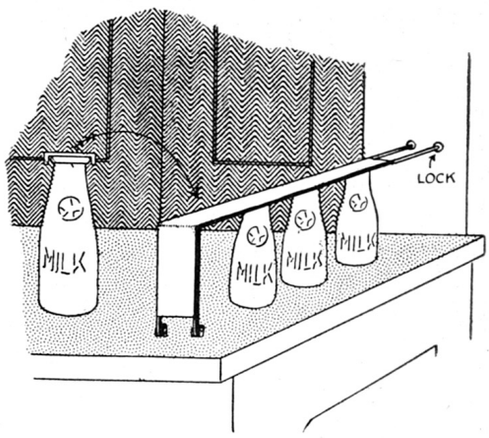
Just before the agent leaves one house to visit another he turns on the electric switch which connects the battery with the wire coil in the handle and this keeps the handle warm, which transmits the heat to his hand. (See Fig. 4.) A device of this construction should meet with welcome from thousands of travelers and people selling goods from house to house.

(*Copyright, 1920, by Jay G. Hobson.*)

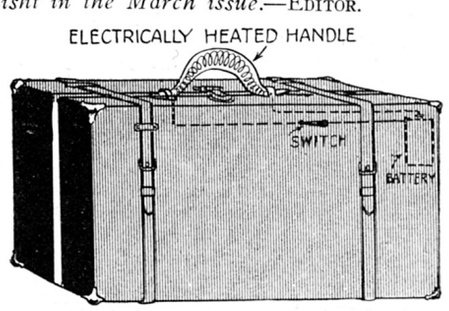
This is the first of a series of articles by Mr. Hobson. The second will be publisht in the March issue.—EDITOR.



Why Monkey Around With Ding Dangled Hair Tonic Bottles and Fancy Squirt Guns for Applying the Tonic—Why Not Devise a Hollow Nozzle Brush Like That Shown and Give One to Each Purchaser of the Hair Tonic?



Ever Have Milk Bottles Stolen Before You Get to Them? Why Not Apply a Simple Grooved Lock Bar Like That Shown? It Locks When the Bottles Are Put in Place.



Agents and Others Who Have to Carry Suit or Display Cases in Cold Weather Should Find This Suggestion for An Electrically Heated Handle of Distinct Interest.

Thomas A. Edison
says of the
"ELECTRICAL EXPERIMENTER"

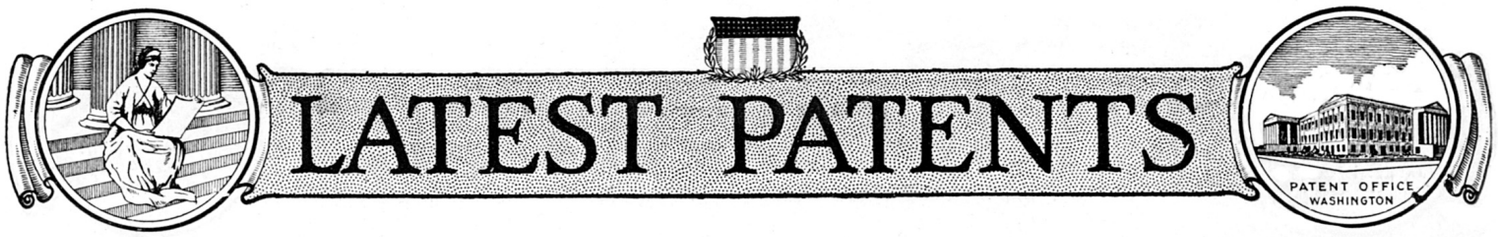
"A very remarkable publication that never fails to interest me. Yes, I do read it every month."

"The ELECTRICAL EXPERIMENTER is a most enterprising publication. It covers a wider field than any other magazine that I know of. I never fail to read it from cover to cover every month, and find the radio articles therein of particular interest."
DR. LEE DE FOREST,
Radio Engineer and Inventor.

"You certainly know what magazine to buy when you go to the newsstand. The ELECTRICAL EXPERIMENTER always has something new to tell us. Every page contains something of interest, told in a clear and concise manner."
COL. L. R. KRUMM,
Chief Radio Inspector,
New York District.

"You have a most wonderfully instructive publication. Its text pages are a constant source of wonder to our people! Your advertising pages, too, present a wealth of information. We have nothing approaching your publication over here."
HENRY C. BRAUN, C. E.,
The Inventor's Engineering Co.,
London, England.

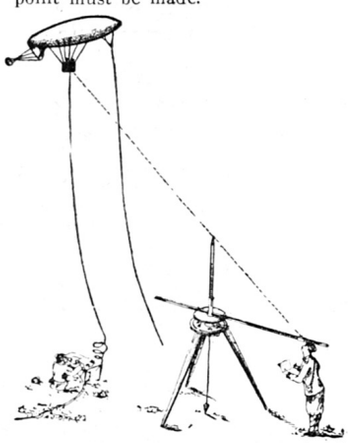
"More thoro in its educational qualities than any other technical magazine publisht. It actually presents not only the marvels of modern invention, but also the fascinating romance of it, which furnishes its powerful public appeal."
RANDOLPH LEWIS,
Publicity Manager, Pathé Films.



Range Finder.

(No. 1,317,670, issued to Ralph H. Upson.)

It is a known fact that a balloon will constantly shift and tilt from the horizontal, and hence corrections for range finding at some distant point must be made.

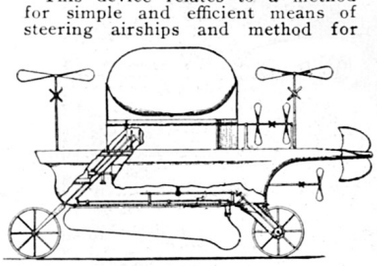


This will have to be taken simultaneously with the data as received by the observation balloon, inasmuch as the findings from the balloon falls under two heads, namely, the distance from the balloon to the distant point, and the angle which a line connecting the balloon with the distant point makes with some fixt base line. With this instrument both the angle of the balloon with any given base line and the distance to the balloon from a ground starting point are obtained at one and the same reading.

Airship Steering Idea.

(No. 1,317,910, issued to Quirino V. Distefano.)

This device relates to a method for simple and efficient means of steering airships and method for

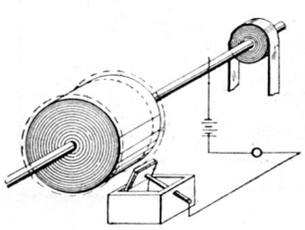


supporting rudders, etc. The drawings designate the body of the machine having a tapering end with the stabilizer mounted thereon. Propellers mounted in every conceivable manner are so arranged that their control is all maintained at one point. A system of cams, pinions and racks serve the purpose of swinging the rudder and steering or elevating the machine.

Balancing Rotors.

(No. 1,319,928, issued to Absolom M. Kennedy.)

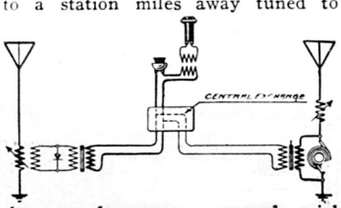
The method consists in spinning the object on an axle which is flexible enough for the object to describe a revolution on an axis of its own selection, thereby bringing the surface of the spinning body in contact with an electrolyte which coincides with the surface of revolution. The electrolyte is carried by a wick and contact is made thru a suitable electric circuit and when its most outstanding surface comes around it engages with the wick. In this way the mass of the rotor is allowed to alter electrolytically inasmuch as its bearings are suitably flexible. Also the parts which require alteration are announced by the flashing of a lamp or other similar indicator.



Wireless Telephone.

(No. 1,313,041, issued to E. F. W. Alexanderson.)

Amateurs and professional operators have always found that it is a tiresome operation and a seemingly unnecessary one to throw the switch over so that the station will be prepared to receive messages and then repeat the operation for sending. Mr. Alexanderson has here incorporated an idea in this recent patent whereby it is entirely unnecessary to use a switch to disconnect either transmitting or receiving apparatus. There are two aerials, placed far enough apart so that the signals of one will not affect those of the other, both tuned to a different frequency. When one aerial is sending to a station miles away tuned to

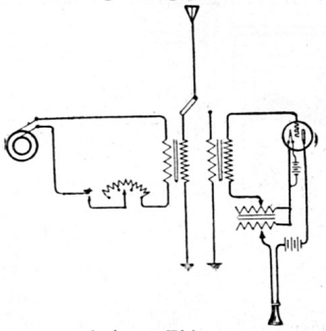


the same frequency, a second aerial is receiving from the distant station, which aerial is tuned to another frequency. Not alone is this a decided feature, but means are afforded whereby any house telephone can be used, thru the agency of a central exchange, for transmitting radio telephone signals, the results of which are identical to carrying on an ordinary telephone conversation without the necessity of change-over switches.

Wireless System.

(No. 1,320,140, issued to Earle C. Hanson.)

This invention relates to the wireless transmission of signals and the object is to provide a means whereby signals can be transmitted, utilizing exclusively "audio" frequencies. It employs transformers having iron cores. The system is claimed to absolutely eliminate all radio frequencies both in sending and receiving. A generator is used



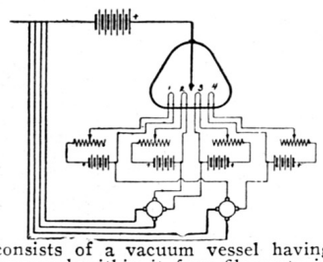
for transmission. This current generated passes thru the primary of an iron core transformer.

The secondary is connected to the aerial and ground, causing electrostatic changes of audio frequencies to be radiated. A vacuum bulb repeater is provided for receiving messages thru a similar transformer to that used in sending. One terminal of the secondary of the iron core transmitter connects to the grid of the vacuum tube, while the other terminal connects to a movable arm of an adjustable transformer also having an iron core. A slider connected to the secondary of this adjustable transformer goes to the phone circuit.

Electric Control Device.

(No. 1,318,196, issued to Theodore W. Case.)

This is a very novel device, and the plan of the inventor is to adopt the same to control or balance airplanes, boats, ships, moving vehicles, and in fact all those which need some stabilizing action. It



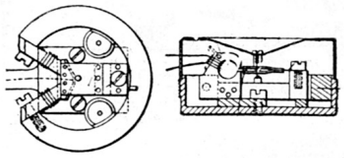
consists of a vacuum vessel having arranged within it four filaments in a circle. Hanging from the top is an unheated electrode, arranged so that it is free to move or swing due to the action of gravity, as the vacuum vessel is tilted or moved from its pre-determined position.

This movement of the unheated electrode causes it to assume a position nearer one or more of the heated electrodes and a greater amount of current will flow from it to the nearest heated electrode. In this way thru the selection of suitable relays various devices may be actuated so as to enable the vessel to remain on an even keel.

Telephone and Radio Receiver.

(No. 1,138,535, issued to Sidney G. Brown.)

This is a decidedly new form of a receiver using a vibrating reed member. It is claimed that maximum elasticity is obtained and that the speech is very clear, inasmuch as the magnetic field can be greatly increased. The reed is mounted in

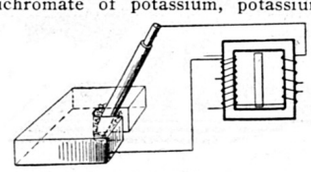


such a position that the magnetic effect of the permanent or electromagnet will affect the reed longitudinally, in this way exerting only a direct pull upon it from its point or base or support. The end of the reed is flattened and is in position so that any received current has a transverse action and affects the reed across the main field. Hence, the elasticity of the reed is independent of the magnetic field.

Arc Cutting Electrode.

(No. 1,321,309, issued to Claude J. Holslag.)

It has been a known fact that with an electrode containing some substance having an affinity for oxygen, such as magnesium, boron, etc., whereby the oxygen of the air or from the metal being welded is rapidly taken up, a strong weld is obtained. Hence, the inventor, working the other way around, has designed an electrode covered with a coating of some compound which will liberate oxygen under heat, such as asbestos impregnated with bichromate of potassium, potassium

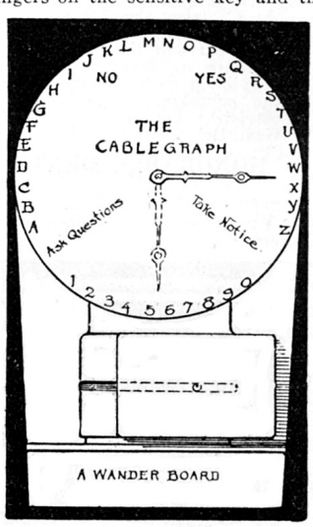


chlorate, etc. In this way oxygen is liberated and the arc forms an ideal cutting instrument.

Spirit Message Recorder.

(No. 1,322,727, issued to George F. Pearson.)

To the many devices which claim to receive and record spirit messages there is now added another by this recent patent. This idea consists of a dial arranged so that the letters and numbers are almost exactly the same, as in the modern Ouija Board. The letters are arranged on a circular disk in the center of which is a hand similar to the hand of a clock. At the lower end is a sliding base. This base connects directly thru a slot in the center with a rack and pinion, the actuating mechanism which turns the hand. It is only necessary for the operator to place his fingers on the sensitive key and the

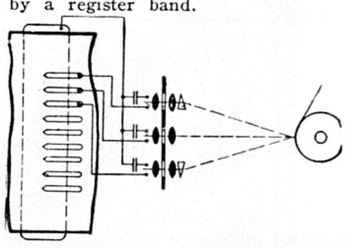


spirit (?) will cause the pointer to move to a figure or number in order to convey the message.

Electric Typewriter.

(No. 1,317,406, issued to W. Von Siemens.)

The invention is for improving the production of printed matter of good quality at very high speed with a typewriter. The type of the typewriter has been improved and type images are thrown by means of stationary templets onto a surface sensitive to light. The time which the image lasts is so minute that the tape need not be stopt at all. No jerks are produced by stopping the heavy paper carriage because of the tape moving continuously. In order that every image of a type may be produced at the correct moment, exposures may be controlled by a register band.



In the figure will be seen the general arrangement of spark gaps, lenses, and screen provided with the type material to be printed. The sensitive paper winds around a carriage. A register band operates spark gaps (by opening and closing a circuit thru contacts made by perforations in the tape, allowing brushes to close the circuit), from which is thrown by the lenses and prisms onto the moving light sensitive surface, an image of the type.

WITH the AMATEURS

Our Amateur Laboratory Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of apparatus unaccompanied by that of the owner. Dark photos preferred to light-toned ones. We pay $5.00 each month for the best photo or photos and $2.00 to each "Honorable Mention." Address the Editor, "With the Amateurs" Dept.

We have not received any "Laboratory Photographs." So "go to it" and send us your photo, together with that of your laboratory. If they are particularly good we may list some new and bigger prizes. So get busy, Boys!!! It's up to you. Here's a way to earn some greatly wanted laboratory apparatus at no cost whatever. Don't be afraid to send in too many photos.

"Amateur Electrical Laboratory" Contest

THIS MONTH'S $5.00 PRIZE WINNER— JOSEPH S. SMIGOSKI

MY "Electrical and Chemical Laboratory" consists of over 200 chemicals and almost as many solutions. (I could not get them all in the photo.) The electrical department has two complete switch-boards and one under construction. I also have a two-inch spark coil, as well as a wireless receiving and transmitting set.

There are several condensers, two D. C. generators and one A. C., also the 110-Volt A. C. house supply connected to the switch-boards. Two buzzers and three bells are connected to various parts of the house.

There are also two transformers, many different coils, an adjustable lamp bank, plenty of switches, and a lot more not shown in the photograph. Telephone and telegraph connections have been establisht between my friends' laboratories.—Joseph S. Smigoski, Gen. Del., Fort Sheridan, Ill.

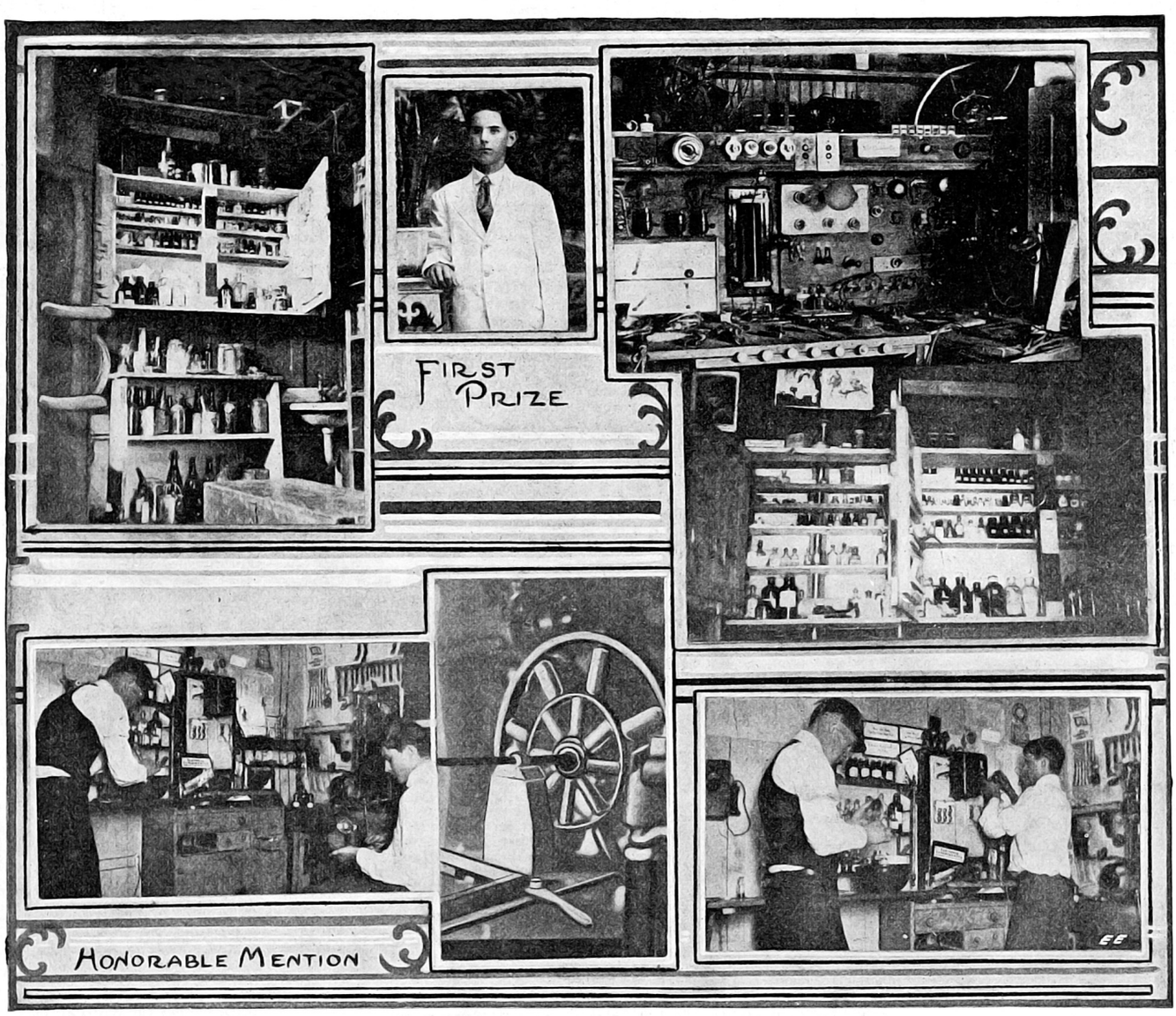
HONORABLE MENTION—J. T. S. and A. J. REESE— $2.00 PRIZE

WE herewith present three flashlight photos of our "Experimental Laboratory."

In the first photograph may be seen our Chemical "Lab.," and electrical test-board controlled from the small switch-board observed in the upper right-hand corner of the picture. This switch-board is so wired that we can obtain two volts, twenty-four volts, fifty or one hundred and ten volts A.C., thru a rheostat and transformer of our own design. We also have in operation a telephone of our own make.

In the second photograph is shown our complete "Lab.," showing the electrical and chemical paraphernalia, which are nearly all of our own handiwork, including a bench lathe driven by a ½ H.P., A.C. motor, and a drill press also driven by a ½ H.P. motor.

The accompanying photograph also shows a 1/20 H.P. motor undergoing repairs under the supervision of A. J. Reese, while J. T. S. Reese is very busy finding the specific gravity of "aqua regia." We are also sending an odd photo of a motor built from a common iron wheel-barrow wheel, and a series of electro-magnets mounted around the iron tire. The rotary magnet coils and cores are mounted on the hub members and axle. The current thru the latter is interrupted by a commutator. We find much useful and interesting information in your magazine, which we read constantly.—J. T. S. Reese and A. J. Reese, 688 Carson St., Hazleton, Pa.



Science in Slang

By EMERSON EASTERLING

Electromagneti-potentiokinetics

THERE were a few of us young disciples of the vibratory-phenomena seated about the open fire that crackled out its glowing warmth upon the contented gathering. From subject to subject we wandered until:

"Say, Jazz," one of the circle spoke, "I can get most of the theoretical wires in the dynamo and motor straightened out in my head—but it don't seem quite that I am *all there* on the 'big know' about the matter. Put me wise, will yuh?"

"Yes," chirped up Punk thru a thick cloud of tobacco smoke, "Rip loose and feed the bunch up on some of this potentiokinetic and vice versa junk—I want a nice nap myself. Don't talk too loud, now."

"I know that the stuff works on the principle of that the wires on the armature whirling around in the magnetic field cut the lines of magnetic force and that the cutting causes an electric flow in the wires—but—but I have a lot of room under the old derby for some more of the *know*.''

This was from Bender, as he twisted a cord around his arm and untwisted the same.

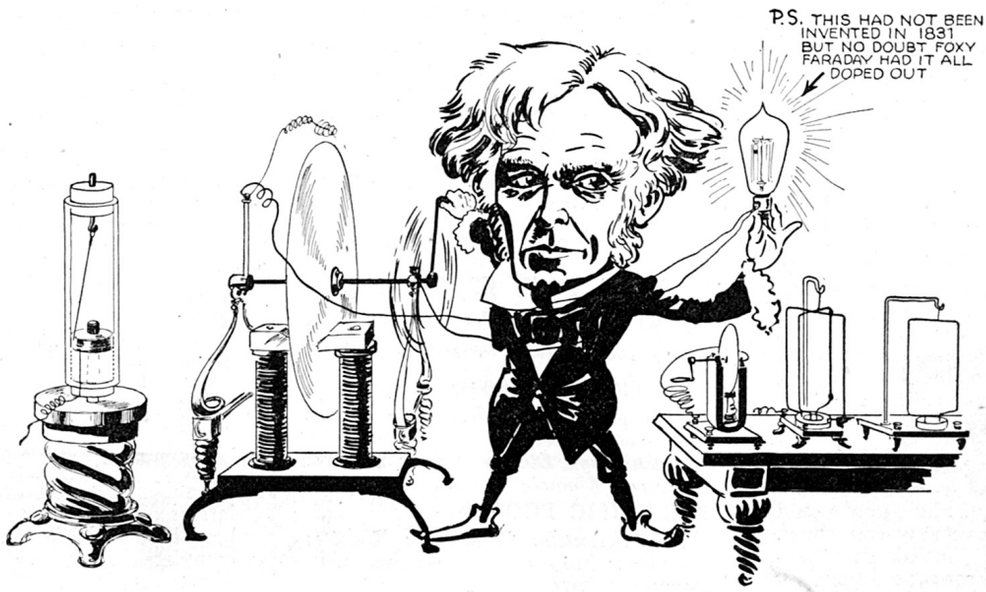
"You know," Jazz began, "that if a current of electricity is caused to flow thru a conductor and that if a magnetic conductor—I mean by that something that does what we term as retaining the magnetism, such as iron—be brought near the electric conductor a magnetic flux will be caused to flow around the electric conductor at right angles to the flow of the electric current; or if an electric conductor be placed so that there is a magnetic flux *fluxing* at right angles to the conductor and the flux be interrupted—as in the spark coil—or the lines of magnetic force be cut as it were by the electric conductor, then a current of electricity will be caused to flow in the conductor.

"I may not be exactly right about that flux being interrupted—but here is what I mean. When the juice stops in the primary there is a flow in the opposite direction in the secondary. As I understand it, the primary circuit sets up a magnetic flow, which in turn sets up an electric flow in the secondary. My hunch runs like this: The primary flow, thru the magnetic medium, sets up an electrical disturbance in the form of disequilibrium, that manifests itself as a flow as soon as the primary is cut off. It is like a teter board—one end the primary, the other the secondary; the current may be represented as a weight on the primary side of the fulcrum. The weight may do kinetic work by dropping. As soon as the weight is kicked off the primary, the secondary bangs down and does its bit. If you were standing under the board you might get the full weight of my argument. It may not be that way, but I believe that the magneto-electric relation that I stuck up before you is the corner-stone to the theoretical electrical conceptional structure—alligatorically speaking.

"Anyhow, one fine morning along about noon in the evening our friend, via History, while experimenting on the stuff that I have just been trying to slip you my 'I-think-I-got-it' about, brought to the surface of the deep sea of the unknown mysteries of Nature (human, feminine, and the kind we prefix 'Mother' to) the fact that if a wire be wiggled before a magnet a current will be found to flow in the wire. Like the cart developed from the drag, the dynamo developed. It was (naturally) found that by forming the wire into a shape sort of rectangular and spinning between the two poles of a magnet that the most amount of what they desired was to be had. Later the single wire armature was put up with more wires, as the makers found that they could get more of the precious what-you-may-call-it that they knew so little about—*littlier* than the little we know—and so later some wise guy pops up and slips an iron core into the wires framework and then stood back and buried his thumbs beneath his vest with a wise smile on his map.

"Mike Faraday in his early experiments with the dynamo used the Earth's magnetic field, by facing the generator East and West. It was not until later that the experimenters found that they could create a stronger magnetic field by mechanical means—magnets, permanent and electromagnetic. Are we so sure but when the early researchers struck out on the trail that stept beyond the primal terrestrial field onto the mechanical, that they did not scent the wrong track? Do you think that the great efficient generators that we have today are the *best* means of harnessing the all-powerful energy that abounds the universe that we have accustomed ourselves to speak of as 'electricity'?

"But to get back closer to home—it was in eighteen hundred and thirty-one that Mike yanked the good one on the residue by giving future work for Noah (Webster) in the 'D' and 'G' departments of his immemorial little trunk pamphlet. He murdered along with discs and cylinders closed at one end—see, when the old boy would have a copper disc placed so that it would display its surface to the poles of an energized magnet and a little juice be shot in at the axle and taken off at the rim that the disc would do the worm stunt. He found that the disc rotated transversely to the direction of the magnetic flux, or lines of force—that's what all the text books peddle.



". . . It Was in 1831 That 'Mike' Faraday Yanked Out His Rotating Copper Disc Trick. The Old Boy Would Have a Copper Disc Pivoted So As to Display Its Surface to the Poles of An Energized Magnet. Current Could Be Taken Off from the Axle and a Brush Bearing Against Its Periphery. The Mazda Electric Lamp . . . But That's Another Story. . . ."

"Sir Charles Wheatstone along about the time the calendar manufacturers were getting used to chisling out 1841, slides into the limelight with a dynamo with a half o' dozen coils in the armature. That was a great stunt in 'them days.'

"In the year of 1845 he and a bird by the name of Cook sneaks into the patent office with the 'papers'. They proved (outside of court) to be the right profiteer on the electro-magnetic dynamo business — they filed away the first electro-magnetic juice pump, in other chatter.

"Jake Brett, along in 1848 got onto the right idea and spun the first self-excited machine. Simplicity and economy, he bellowed.

"Then Werner von Siemens (the guy herding the ancient public in the picture of the primitive trainload of masqueraders in the October issue) knocks at the door of recognition and shimmies in with the first drum wound motor. That step of his sure *took;* they are doing it yet down at the factories.

"Then Gramme pulls a boner somewhat like the Werner stunt—only he used some old unused iron wedding ring from the elephant quarters of the Zoo. We use something like it to-day in our experimenting. Sometimes.

"But before 1880 the generator stuff was like the aerial transportation is to-day. After Edison, the General Electric Company, Westinghouse, and some of the other big frogs took their coats off we had the pleasure of witnessing some pretty good forms of generators and motors. From the old bi-polar types we emigrated into the fields of the multi-polar, even experimenting with the meglapolar freaks.

"Then after Nick Tesla got us wisened up on the alternating current question we have produced some pretty good junk in the line of alternating current motors, generators, and ever'thing. The direct current has it over on the a. c. for power, but where the d. c. is not to be had as easily we have stuck in some pretty fair a. c. spinners. The three phase (that we dwelt on for a few paragraphs in the article on alternating currents) is the best

(Continued on page 1054)

THE ORACLE

The "Oracle" is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., **must** be on separate sheets. Questions addrest to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of **25 cents** is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

WHAT CAUSES BURNOUT OF GENERATOR?

(1036) Theodore Mucha, Lajitas, via Alpine, Texas, writes the "Oracle" department:

Q. 1. Asking as to what could cause a short-circuit and burn-out of a radio transformer and also the generator supplying this transformer.

A. 1. If we understand your question correctly, you apparently wish to know, for the purpose of demonstration or otherwise, what would cause the *secondary* as well as the *primary* windings of an open core transformer, presumably that utilized with a radio transmitter, together with the windings of a self-exciting generator, to be "burned out." There are several cases that would cause this, among them being the following: One of the commonest and most usual sources of this causation would be a broken down secondary condenser. No matter whether this condenser happened to be connected across the secondary of the transformer or in series with the spark gap and oscillation transformer primary, a rupture of one of the condenser units or plates would cause a heavy overload on the secondary winding, which would invariably result in burning it out or destroying its insulation by heating up the winding above normal. Naturally, when the secondary is overloaded and carrying a heavier current than normal, the primary winding will also be overloaded, and likewise this increased load will back up as far as the generator supplying the current. The overload would have the same effect on the generator as on the transformer, i. e., it would cause the windings to heat up, due to the heavier current drawn from them, and cause the insulation to become charred or disintegrated, creating a general failure of the winding insulation and a break-down of the machine.

There are several other difficulties which may arise in the operation of such an apparatus which would cause a failure in the insulation of the transformer and invariably the generator, such as a short-circuited spark gap or a heavy "leak" current thru the base of the spark gap due to dampness or other trouble. We have seen transformers burn out more than once from a short-circuit or partial short-circuit caused by the current leaking thru a defective insulating terminal on the secondary. Another cause or method of causing a triple burn-out such as you describe would be a short-circuit or series of short-circuits in the secondary winding of the transformer itself. There are several ways in which these short-circuits might act. They might cut out a part of the secondary winding in such a way as to cause an abnormal current to flow, or short-circuit a certain section of the secondary turns, thus being the cause of heavy currents set up, which would act in the same manner as if a heavy load were connected across the secondary terminals. Another cause for such a phenomenon might be a complexity of "grounds" occurring in the primary and secondary circuits, which might under certain conditions cause a sufficiently heavy current to pass thru the transformer windings and burn them out, owing to the heavy current thus permitted to pass by the *grounded* circuit.

WANTED!!!

"ODD PHOTOS" AT $1.00 EACH

Here's what we want! What have you got?

ELECTRICAL PHOTOS—

New photos of Lightning; new and unusual Electrical Apparatus and Machinery; Electric Signs; Electric Autos; Electric Clocks.

SCIENTIFIC PHOTOS—

New Scientific Apparatus; Results; Effects; Motion Pictures; Stunts.

OPTICAL PHOTOS—

Peculiar stunts obtained with various lens arrangements; odd film effects caused by unusual conditions; novel micro-photographic subjects.

ASTRONOMICAL PHOTOS—

New eclipse photos; star and moon effects caught by the camera; comets; shooting stars; progressive moon studies.

FREAK PHOTOS—

Odd double and triple exposure effects; novel and striking effects due to unusual exposures.

MECHANICAL PHOTOS—

Electrical and Mechanical apparatus of unusual news interest.

RADIO PHOTOS—

New stations, both commercial, government, and private. Owners of private or amateur stations will find a special contest for these photos on another page of this issue. And don't send us plate or film "negatives"; send unmounted or mounted "prints" preferably a light and dark one. Enclose stamps if photos are to be returned.

Address photos to—Editor "Odd Photos", Electrical Experimenter, 233 Fulton Street, New York City.

ASTRONOMY QUERIES.

Question 1. If the approximate motions of the stars be anywhere between speeds of ten and fifty miles per second, why, in the course of a year can we find no apparent movement in a star traveling at right angles to us? Isabel M. Lewis answers:

Answer 1. We can detect such motion for many near stars. The motion of a star thru space as seen from the earth can be separated into two components, the "proper motion" or motion across the line of sight and the "radial velocity," motion towards or away from the observer in the line of sight. The latter component is measured in direction and amount by means of the spectroscope; the former is found by angular measurements of the displacement of the star with reference to fixed points. The universe is fashioned upon such an enormous scale that this angular displacement of a star due to its motion across the line of sight is very small. There are very few stars for which it amounts to as much as a second of arc a year while for many stars it does not amount to a second of arc even in a hundred years. Nevertheless such a motion of the stars does exist and by taking the time interval sufficiently long it can be detected.

Question 2. I understand that the stars of a constellation are named first by the letters of the Greek alphabet, then by numbers in order of magnitude. I would like complete information on the nomenclature for I see in star lists such names as χ^1, Orionis, 388 B. Leonis, S. Andromedæ, etc.

Answer 2. In general the brightest star in a constellation is known as Alpha, the second brightest Beta and so on but this convention has not been strictly followed in all cases or else certain stars have changed in relative brightness since they were named by early uranographers. For instance Beta Geminorum (Pollux) is brighter than Alpha Geminorum (Castor). The thousands of stars in star catalogues cannot, of course, be designated by Greek letters and they are usually known by their numbers in a certain catalogue, the distinguishing letter of the catalogue following the number. 388 B. Leonis is No. 388 in Bradley's catalogue.

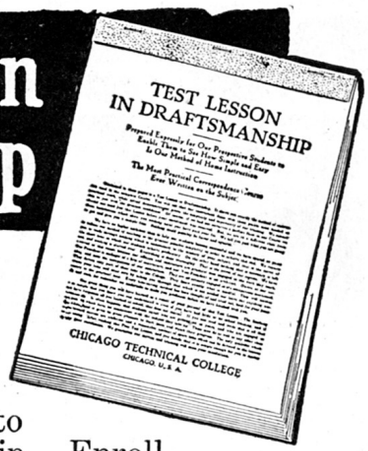
The letters R, S, SS, RZ, etc., have been employed in more recent times to designate variable stars in a constellation.

Such notations as χ^1, χ^{11} are used to designate the two components of a double star, named in the order in which they cross the meridian.

Question 3. Kindly explain the precession of the equinoxes.

Answer 3. The "precession of the equinoxes" is a gradual westward shifting of the point of intersection of the ecliptic with the celestial equator, (the vernal equinox or first point in Aries) which amounts to 50".2 annually or thirty degrees in two thousand years. It results from the slow revolution of the earth's axis around the pole of the ecliptic which is in reality the "wobbling" of a rotating body acted on by external forces arising from the fact that the rotating earth is not a perfect sphere but has an "equatorial bulge" which is attracted by the sun and moon in such a way as to tend to draw the plane of the equator down into the plane of the ecliptic and the pole of the equator into coincidence with the pole of the ecliptic. As a result of the action of these forces the pole of the equator describes a circle with a radius of 23½° around the pole of the ecliptic in 25,800 years (360° divided by 50".2).

FREE Test Lesson In Draftsmanship



Send for this free lesson which explains the Chicago "Tech" method of teaching Draftsmanship by mail. Positions at big salaries are now waiting for competent men. Even draftsmen of limited training and experience are snapped up and paid good salaries. If you are dissatisfied with your opportunities, learn Draftsmanship. Chicago "Tech" will train you in the most practical way in the shortest time. Mail the coupon today and let us tell you about the Chicago "Tech" method. The free lesson will show you how well equipped you are to follow Draftsmanship. Enroll in the course only if you decide that you can take it up to advantage. No cost, no obligation on you to make this investigation. Send the coupon.

$25 to $100 a Week

Draftsmen always command good salaries. And now when American industries are to be called upon to meet vast foreign and increased domestic demands, the opportunities are greater than ever. This is the time for you to prepare for a better position—a higher salary.

Come to the College or

Learn At Home

Hold you present position while training. Our experts will instruct you by mail. Only your spare time is required. You are directly under practical draftsmen and engineers. You are taught exactly the work required in the drafting rooms of big concerns. No time put in on unnecessary studies. This means thorough instruction and early graduation.

Easy Payments

The fees for Chicago "Tech" Courses are very moderate—and you can pay on easy terms. And also, you obtain in a few months what it would take several years to acquire by ordinary methods. You can get an early start. You are soon ready to take a paying position and to quickly get back the cost of your course. Then keep on earning more.

FREE Instruments

Every student of the Chicago "Tech" mail course in Draftsmanship receives this set of instruments, or a cash credit in case he already has a set. These instruments are of the same make and sizes as are used by high salaried experts in drafting rooms of factories, shops, railroads, etc. You use them while learning—then take them right into your practical work.

Auto and Gas Engine Course

All about automobile mechanism—its construction, operation and REPAIR—taught by mail. You train directly under the Chicago "Tech" automobile experts. Splendid opportunities open now. Send coupon and get all the facts.

Learn All This in Spare Time

Principles of the Automobile. Every point made clear about the basic principles of propulsion—steam, gas and electric cars. Power transmission systems in pleasure and commercial cars, etc., etc.

Gasoline Engines. All about the different types. A complete course in gas engine construction, operation and repair.

Power Plants and Transmissions. Application of power by 4-6-8-12 cylinder engines. Types of clutches, gears, drives, axles, etc.

Carburetors and Fuel Supply Systems. All methods demonstrated. Fuel values. How to test. Gasoline and air mixtures. Regulation, care and management, etc., etc., etc.

Lubrication and Cooling. All about oils and how to test them. Splash and circulating systems. Operation in different cars explained. Diagrams and tables. Cooling systems completely illustrated, etc.

Batteries. Electrical principles explained. Instructive diagrams of wiring and connections. Coils, condensers, vibrators, etc., etc.

Magneto Ignition. Principles and practical operation of various types and systems with diagrams. Generation of current. Field, armature, high and low tension, all explained. Complete in every point.

Starting and Lighting Systems. All modern methods. Starters—spark, mechanical, air, acetylene, electric, battery—shown in detail with diagams and full explanations. Charging. Motor and generator adjustments, etc., etc.

Know How to Find and Fix Troubles

Most complete instruction in auto repair work. Equips you for high pay or to start a business. Big demand for trained repair men and men who know how to inspect cars. This course makes you proficient. Prepares you to take a job as an expert. Not enough competent men now available.

WRITE Send the coupon and get catalog and all information about the Course, the small fee and the easy terms. All this sent on request. Mail coupon now.

Send the Coupon—Now

The sooner you are prepared the sooner you will be holding a job that pays a large salary and opens the way to advancement. Many executives, general managers and superintendents began as draftsmen.

Other institutions ask you to pay first—and then to find out later how well qualified you are for this profession. We send you the free lesson first and place you under no obligation at all. Discover your qualifications before you pay anything.

The coupon will bring the Test Lesson, free. Also information about the profession of Draftsmanship and detailed facts about Chicago "Tech" methods, the fees, terms, etc. Mark with X the branch you are interested in—or if in doubt about which course to take, write a letter stating facts about yourself and asking our advice which will be freely given. Mail either the coupon or letter today.

CHICAGO TECHNICAL COLLEGE,
245 Chicago "Tech" Building, Chicago

Without obligation to me, please send me your FREE Test Lesson and other interesting literature covering the subject indicated below.
Mark X opposite work in which you are especially interested.

- ☐ Architectural Drafting
- ☐ Machine Drafting
- ☐ Electrical Drafting
- ☐ Structural Drafting
- ☐ Sheet Metal Drafting
- ☐ Builders' Course
- ☐ Plan-Reading—Building
- ☐ Plan-Reading—Shop Men
- ☐ Estimating
- ☐ Surveying
- ☐ Map Drafting
- ☐ **Autos and Gas Engines**

Name .....

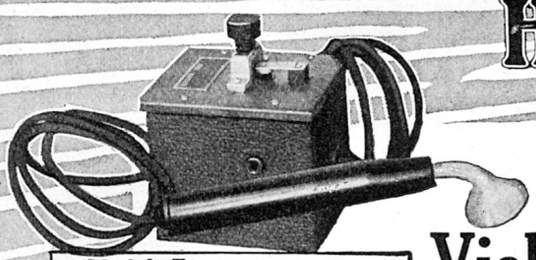
Address .....

City ..... State .....

College or Home Study? State which .....

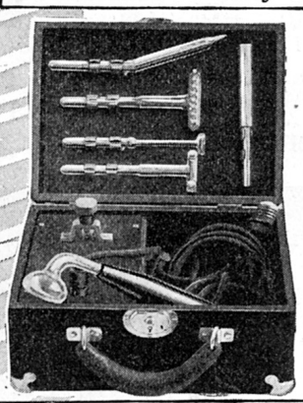
Chicago Technical College 245 Chicago "Tech" Bldg. Chicago, Ill.

Powerfully Effective Health and Beauty Giving



Model E— Lowest priced, efficient Violet Ray in the world. Simple and effective. Thousands in daily use.

A Complete Line of Violet Ray High Frequency Generators of Scientific and Practical Design



Model B—Excellent example of modern Violet Ray for Home and professional use.

The demand for ***Renulife Ray Violet Generators*** has increased by leaps and bounds. Thousands are now in use in homes, hospitals, sanitariums, doctors' office, beauty parlors, etc. Every mail brings us unsolicited statements of truly remarkable results obtained with the Renulife—results beyond any claim that we, with all our confidence in this effective mode of treatment. would care to make.

The constantly growing demand for Renulife Violet Ray apparatus has prompted us to increase greatly our laboratories and manufacturing facilities and add several new models to the ***Renulife Line.*** Embodied in Renulife Generators are improved patented features giving the advantage of greater simplicity, strength of current, durability and convenience. And our enlarged facilities including special ingenious manufacturing machinery, developed by our inventors together with our present production schedule has made possible, in spite of much higher material and labor cost to continue to sell

Renulife Generators At Pre-War Low Prices

Model C—An instrument of varied uses providing selective currents and built-in ozone generator.

Better instruments both from a technical and therapeutic point at unchanged prices—the same low prices that brought the Violet Ray within the reach of every one and that always have represented the maximum of value. This is a considerable achievement in view of the raise of 30% to 50% made by other manufacturers.

If you are not familiar with the uses and benefits of the Violet Ray and the modern instruments which have made the Violet Ray entirely safe and effective in the hands of any one—write for full particulars. Get our book just issued giving interesting Violet Ray data, showing full line of different models and quoting low pre-war prices.

Write today for Full Particulars

In addition to the three shown above there are several other Renulife models all of the portable cabinet type—the approved design with light handle and ample sized and efficient units.

Opportunity for Capable Sales Distributors and Agents

We have an attractive proposition for those qualified to handle our line. Some good territory still open. Write our Sales Manager for particulars.

For headache, neuralgia, etc., sure relief.

Goitre reduced thru penetrative Violet Rays.

Renulife VIOLET RAY

Unequalled for Rheumatism, Neuritis, Muscular Soreness, pains and aches.

Read How Renulife Benefits

A recognized scientific effective means of handling your own case is afforded by the RENULIFE VIOLET RAY HIGH FREQUENCY GENERATOR. It is so designed and made that anyone can apply the wonderful corrective, upbuilding forces of the VIOLET RAY. This pleasant POWERFUL form of electricity has done and is doing wonders in relieving and eliminating pain and suffering. You owe it to yourself to investigate —find out the facts. Get our new booklet explaining the nature of the Violet Ray —its uses, benefits, and applications—send the coupon below at once.

Thousands of Volts

No Shock—No Harm— Simply Great Benefits

Current from your light socket is transformed into the most powerful, effective purifying Health and Beauty giving agency; yet as painless and pleasant as a ray of sunshine. Made safe for use in any home, on infant or weakest invalid. Attacks the deep seated source of diseases, at the same time relieving the aches and pains which may be the annoying symptoms. Learn how this modern form of electricity — The Violet Ray — so acceptable to the human body actually saturates the whole system with invigorating life-laden forces, bringing back normal conditions. You may treat the local area but results are not confined to that part alone—the blood, nerves, tissues are revitalized, toned and restored.

Send for the Booklet—full of information—that tells the story so you can understand it.

Nature's Own Aid

What is the strange relation between electricity and life? Some declare electricity *is* life. We do not know But life cells do welcome and respond marvelously to electricity in the form of Violet Rays. It works with nature to restore where many other methods fail. It treats fundamentally and therefore is specified by physicians for a wide range of ailments—for rheumatism, neuritis, nerve and blood disorders—etc., etc.—both chronic and acute. See the list on coupon and ask for full particulars. Blood is brought to area treated—enriched and purified—assimilation and digestion improved—functions restored to normal. Combines the benefits of electricity, vibration, exercise, stimulation, and oxidation. Get the information as to what you may expect from the Violet Ray. Its astonishing low price places it within the reach of all. The Trial Plan *proves* its value, in actual use. Receive full information by return mail.

Renulife Electric Company, Inc.

1213 Marquette Building, Detroit, Mich.

Chicago Office, Room 410, 123 West Madison

CANADIAN RENULIFE ELECTRIC COMPANY, LTD.

1213 Netting Building, Windsor, Ont.

Statements of Users

"The Renulife Violet Ray High Frequency Generator is superior in efficiency because of its perfect character and control of current, compactness and perfect insulation. The smallness and lightness of Electrode holder is also a great advantage." The doctor told me that the trouble was hardening of the arteries. I would not be without it for all the money in the world." "I cannot recommend it too highly." "I have been using mine now for a week for Sciatica and I am highly pleased with results." "I think it is one of the best little machines that was ever invented." "I have used it with excellent results for the restoration of hair and stiff and sore rheumatic finger joints." "Am well pleased with the Generator, and the kind treatment received from your Company." "My Generator has stopped my Neuritis." "Every house should have a Renulife Violet Ray High Frequency Generator for the treatment of Neuralgia; Neuritis; Sore Throat; Kernels in Neck; Cramps; Headache, Stiff Neck; Muscular Soreness; Rheumatism; Paralysis—in short, pain of all kinds."—M. D.

"I have been much relieved by the use of your Violet Ray Generator."

"It is fine for insomnia."

"I find it such a help in nervousness."

"I would not part with it for five times the price. It is sure a little wonder."

"I am more than pleased with the Generator, the whole family are using it."

Increases energy, vitality —a general tonic, improving circulation.

Ozone—inhaled for catarrh, throat and lungs—also Anemia

Get This New Violet Ray Book

Treat your own skin and scalp—no aid like Violet Ray.

BOOK FREE

MAIL POSTAL OR

Send Coupon

COUPON FOR BOOK and Special Information

RENULIFE ELECTRIC CO.,
1213 Marquette Bldg., Detroit

Please send without obligation, your book "Health," explaining Violet Ray treatments with Renulife Generators; also give full particulars as to its application for ailments checked below.

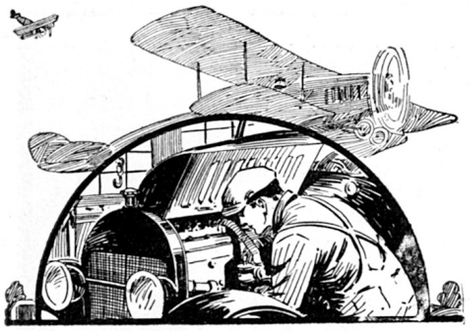
TREATS SUCCESSFULLY

..Abscesses	..Facial Neuralgia	..Obesity
..Anemia	..Falling Hair	..Pain in Abdomen
..Asthma	..Female Complaints	and chest
..Arteriosclerosis	..Goitre	..Paralysis
..Baldness	..Gout	..Piles
..Blackheads	..Haemorrholds	..Pimples
..Brain Fag	..Hay Fever	..Pyorrhea
..Bronchitis	..Infantile Paralysis	..Rheumatism
..Bunions	..Insomnia	..Scars
..Bruises	..Lameness	..Sciatica
..Catarrh	..Locomotor Ataxia	..Skin Diseases
..Colds	..Lumbago	..Sore Throat and
..Chilblains	..Nervous Affections	Throat Diseases
..Dandruff	..Neuralgia	..Sprains
..Deafness and Ear Diseases	..Neuritis	..Toothache
..Eczema		..Weak Eyes
..Enlarged Prostate		..Wrinkles
		..Warts and Moles

Name .....

Address .....

.....



Eight to Twelve Dollars a Day for *You!*

From eight to twelve dollars a day is good pay—probably twice as much as you are now earning—yet you can step into scores of openings as an auto mechanic that will pay you one dollar or more an hour—$50 to $75 a week—$200 to $400 a month.

Big Demand; Your Opportunity

Every auto in use needs the trained brain and skilled fingers of a mechanic one or more times a year. This means that over **five million cars** need expert attention yearly. Hundreds of thousands of new cars are being sold and adding to the demand for men who are good mechanics. It takes several weeks now to get a car repaired because of the lack of men to handle them. Farm tractors by the thousands also need attention—and the aeroplane is also becoming as popular and as useful as the automobile. Every aeroplane, tractor and auto being built—every one now in use—means work at good pay for men who can act as "doctor" to them. The demand for automotive mechanics is abnormal.

SATISFACTION GUARANTEED — YOUR MONEY BACK IF YOU ARE NOT SATISFIED AFTER COMPLETING TEN EXAMINATIONS

Get Ready at Home

You can quickly qualify for a good position as automotive mechanic without interfering with your present work. Let us send you our Free Bulletin explaining our methods—also our Money-Back Guarantee. You risk nothing, so check and mail the coupon at once.

American School of Correspondence

Dept. F-262 Chicago, U. S. A.

TRAINING—THE KEY TO SUCCESS — ASC

Explain how I can qualify for the position checked.

.....Automobile Engineer	.....Shop Superintendent
.....Automobile Repairman	.....Steam Engineer
.....Airplane Mechanic	.....Draftsman and Designer
.....High School Graduate	.....Lawyer
.....Electrical Engineer	.....Business Manager
.....Electric Light and Power Superintendent	.....Certified Pub. Acc'nt
	.....Accountant and Auditor
.....Hydroelectric Engineer	.....Bookkeeper
.....Telephone Engineer	.....Stenographer
.....Telegraph Engineer	.....Fire Insurance Expert
.....Wireless Operator	.....Sanitary Engineer
.....Architect	.....Master Plumber
.....Building Contractor	.....Heating and Ventilating Engineer
.....Civil Engineer	
.....Structural Engineer	.....Gen'l Education Courses
.....Mechanical Engineer	.....Common School Branches
.....Photoplay Writer	.....Employment Manager
.....Foreman's Training Course	

Name.....

Address.....

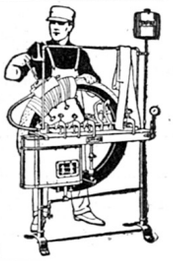
AN EASY WAY TO MAKE MONEY

Don't be content to plod along on a small salary. Be independent. Go in the tire repairing business. One man says "I made $60.00 the first day." Others average $200 to $500 a month. Very little capital needed. Jobs plentiful. Every motorist a possible customer. No experience needed. We teach you.

SHALER Tire Repair Outfit

Improved Wrapped Tread Method Used by Tire Manufacturers

Does as good work as the big high priced vulcanizing outfits. A boy can use it. It's the only vulcanizer that has Automatic Heat Control, and can't undercure or overcure a tire. Requires no watching or regulating.



FREE Book

"How to Open a Tire Repair Shop." It tells how to make big money. Don't delay. Write quick.

C. A. SHALER CO.

2201 Fourth St. Waupun, Wisconsin

How Becquerel Discovered Radioactivity

By JEAN BECQUEREL

(*Continued from page* 996)

ing a few days later, Becquerel then took out the prepared plate on which salts of Uranyl had remained, but, due to the natural precaution of a conscientious research physicist, he thought it best to change the photographic plate before resuming the experiment. Accordingly the plate, which had rested for several days in the drawer, was removed from its envelop and placed in the developing solution which happened to be at hand. While preparing the new plate, he watched the developing of the old one and observed with perfect amazement that it gave an impression far stronger than that of the first plate, which had remained for a few hours under the action of the Uranyl Salts, and exposed to the sun.

This immediately threw light on his whole subject; he understood at once that the action had taken place in the drawer *away from all exciting light and without the emission of any phosphorescent light* of the Uranyl Salts, because the luminosity of these Salts ceases within 1/100 of a second after being exposed to light. He immediately made a series of experiments with various Uranyl Salts which had remained away from light for some years; the results were always the same. However, one puzzling problem remained, but Henri Becquerel solved it as soon as he had taken it up. Was this new property due to the fact that the salts were phosphorescent (tho it was not necessary to first excite this phosphorescence) or simply due to the fact that they were Salts of Uranyl? All non-phosphorescent uranium salts were tried, as well as later on, uranium metal itself. The results were always the same, even when protecting the substances against all exterior radiation by putting them in a thick lead box. When exposed for the same length of time, the impressions obtained on the plates were more intense according to the greater richness in uranium salts of the composites. The new phenomenon was *atomical;* that is to say that it depended upon the atom of uranium, whatever its chemical combination might be.

From that time on there was no more doubt; Uranium and its composites emitted *spontaneously* a radiation which penetrated opaque bodies. It was an entirely new phenomenon and an unexpected property of matter. *Radioactivity was discovered* (March 1st, 1896).

Thus the study of electric phenomenon led Antoine Caesar Becquerel to study the action of discharges on phosphorescent substances; Edmond Becquerel, who had collaborated in this work, continued the study of phosphorescence and realized the exceptional properties of Uranyl Salts. Henri Becquerel wisht to go deeper into the problem and found *Radioactivity*, with which these labors were crowned.

Henri Becquerel, in his extreme modesty, liked to say: "The discovery of radioactivity *was bound to be made* in our laboratory and if my father had lived till 1896, *he* surely would have been its discoverer."

Immediately after this discovery, all of Henri Becquerel's new experiments became new conquests. It did not take him long to find out that the Uranium radiation discharges electrified bodies by making gases conductive to electricity. This fundamental property is still to-day the only one which permits us to measure the energy of these rays; it is also this property which permits us to prepare radioactive substances.

While Henri Becquerel was studying the nature of the radiations he had just discovered, M. and Madame Curie were making researches as to whether there existed other bodies presenting the same properties. Their splendid researches revealed, shortly after, that "Thorium" radiates just as Uranium, and brought about the discovery of products a great deal more active, such as Polonium and Radium. This last body has an activity about 2,000,000 times greater than that of Uranium. About the same time, M. Debierne discovered another very radioactive element which he called "Actinium."

Radium, because of its great activity, permitted a very much more complete study of this new phenomenon. With the small quantity of radium which Curie gave him, Henri Becquerel found out that its radiation excites the luminosity of phosphorescent substances and that Radium is able to produce radiations in a very diversified and penetrating manner. He also discovered that a magnetic field influences the radiations of radium and he obtained on a photographic plate clearly separate traces of the two different radiations which have been called Alpha and Beta rays. By an ingenious and simple method, he obtained a great number of photographic proofs showing that Beta rays are deviated by a magnet. He furthermore demonstrated the influence of an electric field on the Beta rays, and by the simultaneous measuring of electric and magnetic deviation he could, as had been done by Prof. J. J. Thomson with cathode rays, calculate the proportion between the charge and the mass of the corpuscles which form the radiation. *He proved beyond doubt that the corpuscles which form the Beta rays are identical with the corpuscles constituting the cathode rays,* but the speeds of the corpuscles reach much higher rates in the case of Beta rays; those which are less deviated by the magnet have a speed neighboring on that of light.

It is quite impossible for me in a short treatise to touch upon all the vast work concerning radioactivity. I will content myself to indicate the principal consequences of the discovery of Henri Becquerel. The corpuscles forming the Beta rays and those constituting the cathode rays are quite identical. Their charge is the atom of electricity, of which all other charges are the multiples. They are called *electrons.* The mass of an electron when its speed is quite inferior to that of light (300,000 kilometers per second) is 1800 times smaller than the mass of the lightest of atoms, namely, the atom of hydrogen. *The electron is the universal constituent of matter.*

Nevertheless, in a pencil of Beta rays, emanating from a radioactive body, the electrons have not all a like speed. This is why the pencil is deflected in a magnetic as well as in an electric field—for the greater the speed, the smaller the deflection. *A fact of great importance is that the more the speed approaches that of light, the larger becomes the mass.*

This result has been explained by the laws of Electromagnetism and by the Principle of Relativity established by Prof. Einstein. This principle, which has revolutionized the basis of mechanics, *shows that the mass of any body must grow indefinitely when its speed tends towards the speed of light* (which is the limit which no body in motion can surpass). *The theoretically established law was entirely verified by the results experimentally obtained with Beta rays.* (Bücherer.)

Everything leads us to believe that the mass of an electron is solely due to the charge that it carries. It is almost certain

(*Continued on page* 1044)

MAGNAVOX

Telemegafone

FOR RADIO RECEIVING

PRICE $75.00

Connect AA to Radio Receiver and BB to 6-volt storage battery

FOR MUSIC AND VOICE

PRICE $150.00

With attachment for Phonograph as shown
Operates from 6-volt storage battery

The Most Efficient Telephone Receiver and Loud Speaker

The most rugged, simple and reliable instrument yet produced for the reproduction of sound

For Radio, it is not only a most sensitive receiver when used with the head-set, but is also the most powerful loud speaker manufactured.

The powerful Magnavox Telemegafone fills a long felt need of public speakers and places of amusement.

The Magnavox Telemegafone enabled President Wilson to speak to 50,000 people at San Diego. The President's Victory Loan message was transmitted by radio telephone from an airplane and reproduced by the Magnavox Telemegafone to 20,000 people assembled in front of the Treasury Building at Washington, D. C.

Immediate Deliveries — Send for Bulletin

THE MAGNAVOX CO.

PATENTED IN U.S.A. AND FOREIGN COUNTRIES

2701-2759 East Fourteenth Street

Oakland, California

You are paying for these books even though you don't have them

The difference between what you CAN EARN with their help and what you DO EARN now is the price you pay. With the money you ought to get but don't, you pay for any set several times over. Every month you can earn enough extra to pay for the set you need. These books bring the expert advice and the most modern approved methods of the world's greatest authorities right to your home. They explain everything you ought to know—they will fit you to get more money out of the work you are doing now—they will fit you to hold a better job—the job you want but have never been able to get. Read our FREE examination offer below, that brings the books to you without cost and guarantees your satisfaction.

Pay-Raising Books at Greatly Reduced Prices

Carpentry and Contracting, 5 volumes, 2138 pages, 1000 pictures. Was $25.00.....Now $19.80
Civil Engineering, 9 volumes, 3900 pages, 3000 pictures. Was $45.00.....Now 29.80
Electrical Engineering, 8 volumes, 3000 pages, 2600 pictures. Was $40.00.....Now 24.80
Automobile Engineering, 6 volumes, 2600 pages, 2000 pictures. Was $30.00.....Now 21.80
Machine Shop Practice, 6 volumes, 2300 pages, 2500 pictures. Was $30.00.....Now 19.80
Steam and Gas Engineering, 7 volumes, 3300 pages, 2500 pictures. Was $35.00.....Now 21.80
Law and Practice (with reading course), 13 volumes, 6000 pages, illustrated. Was $72.00. Now 44.80
Fire Prevention and Insurance, 4 volumes, 1500 pages, 600 pictures. Was $20.00.....Now 15.80
Telephony and Telegraphy, 4 volumes, 1728 pages, 2000 pictures. Was $20.00.....Now 14.80
Sanitation, Heating and Ventilating, 4 vol., 1454 pages, 1400 pictures. Was $20.00.....Now 14.80
Practical Accounting, 4 volumes, 1800 pages, 800 pictures, etc. Was $20.00.....Now 14.80
Drawing, 4 volumes, 1578 pages, 1000 pictures, blueprints, etc. Was $20.00.....Now 14.80

Send No Money
Shipped for 7 Days' Trial

Write the name of the books you want on the coupon and mail it today. We will send the books at once, express collect, and you can use them just as if they were your own for a whole week. If you decide you don't want to keep them, send them back at our expense.

Only 50 Cents a Week

If you like the books, as thousands of other men have after examination, just send us $2.80. You can send the balance of the special reduced price the same way—$2.00 each month (for Law $3.00). Start right now and fit yourself for a better job and bigger pay. The better job will be looking for you if you do. Be ready to meet it when it comes. SEND THE COUPON NOW.

American Technical Society, Dept. X-252 Chicago, U. S. A.

American Technical Society, Dept. X-252 Chicago, U.S.A.

Please send me set of .....

.....

for 7 DAYS' examination, shipping charges collect. I will examine the books thoroughly and, if satisfied, will send $2.80 within 7 days and $2 each month (Law $3) until I have paid the special price of $.....If I decide not to keep the books I will return them at your expense at the end of one week.

Name.....

Address.....

Reference.....

(Please fill out all three lines.)

How Becquerel Discovered Radioactivity

(*Continued from page* 1042)

that this conclusion must be extended to all matter of which the inertia is of entirely electric origin.

It becomes necessary therefore to give up the doctrine of the constancy of the mass of the old Newtonian mechanics: The constancy of a mass is only an approximation for the case of speeds greatly inferior to that of light; an approximation, by the way, perfectly legitimate in practise.

The Alpha rays are particles charged with positive electricity propelled by a speed of from 15,000 to 23,000 kilometers per second, depending upon the radio-active Substance which emits them. It has been proven that each particle is an atom of Helium gas positively charged by losing two electrons. (Helium is one of the rare gases contained in the atmosphere.)

Helium therefore appears to be a primordial element, the atom of which serves to build up more complex atoms. This is a wonderful fact!

There exists still a third kind of rays—Gamma rays. These are identical with X-rays, of great penetrating power. Despite their enormous speed, Alpha and Beta particles do not go far when they penetrate into a body. In solid bodies they are quickly stopt and in gases they also lose their speed because of the collisions they experience with the molecules. Then every time such a tiny projectile meets an obstacle, heat is the result. For that reason radium becomes hot under the action of its own rays; it is always at a temperature higher than the ambient temperature. One gram of radium disengages 132 calories per hour; that is to say, a quantity of heat sufficient to melt almost double of its weight in ice. This heat is due almost entirely to the Alpha particles whose energy constitutes 95% of the total energy of the radiation.

M. Rutherford discovered in 1900 that Thorium disengages continually a radio-active gas: Radium and Actinium possess the same properties. These gases are called "Emanations" and they transform themselves rapidly. Their *period,* which is to say, the time needed to become half-transformed, is from three to eight days for the Radium emanation; 53 seconds for that of Thorium, and only 3.9 seconds for that of Actinium. Messrs. Ramsay and Soddy observed that Helium is generated in direct ratio as the emanation of Radium disappears: this Helium is nothing other than the Alpha radiation emitted by the emanation. What is more, every object exposed to the emanation becomes radio-active itself, but this effect disappears soon. This is the inductive Radio-Activity discovered by Curie.

This transferred radio-activity itself is later replaced by less active but more stable products.

Professor Rutherford explains all these facts by his admirable theory of the Evolution of Matter. Each active body of large atomic weight, such as Uranium, Thorium and Actinium, gives birth to a family of elements of which each is produced by the preceding one; also, at each emission of Alpha rays, Helium is produced.

These elements are more or less ephemeral, altho the average life of an atom varies in wide limits, the average duration of life of the Uranium atom is 7 billion years—Actinium, 5½ seconds, and that of Actinium 1/500 of a second.

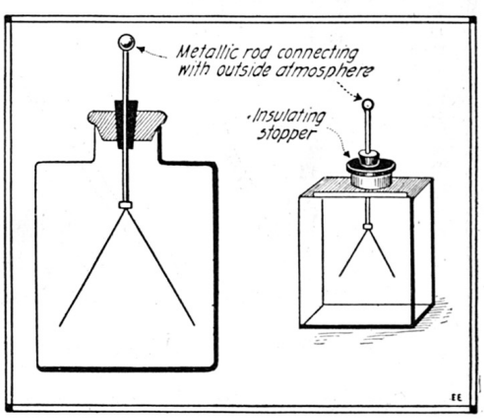
Uranium is the ancestor of Radium, of Polonium, and in this family it is very probable that, besides Helium, the final product, which appears stable to us, *is lead.*

It is essential to note that the radio-active transformations are not chemical decompositions for their character is absolutely different; they are spontaneous—they are independent of temperature effects and no physical agency can modify them—at least not within the limits of the average actions which we have at our disposal. Moreover, they bring into play a colossal energy.

Thus it is that radio-active bodies are not composite bodies—they are elements the atoms of which convert themselves. In this case it is a transmutation or, more exactly, a *disintegration of matter.*

Is radio-activity a general property of matter? It is quite natural to believe so. It is probable that all matter undergoes a transformation, the average life of ordinary atoms being at least several dozen trillions of years. The slow speed at which these transformations occur gives us the illusion of stability.

The phenomenon of radio-activity then teaches us that matter is not unchangeable, that elements become transformed and that they constitute a great reservoir of energy; one single gram of Radium which transforms itself completely into Helium and finally into Lead, furnishes as much energy of combusion as 500 kilograms of coal, and this is only an infinite part of its total energy, *for there still remains the energy*



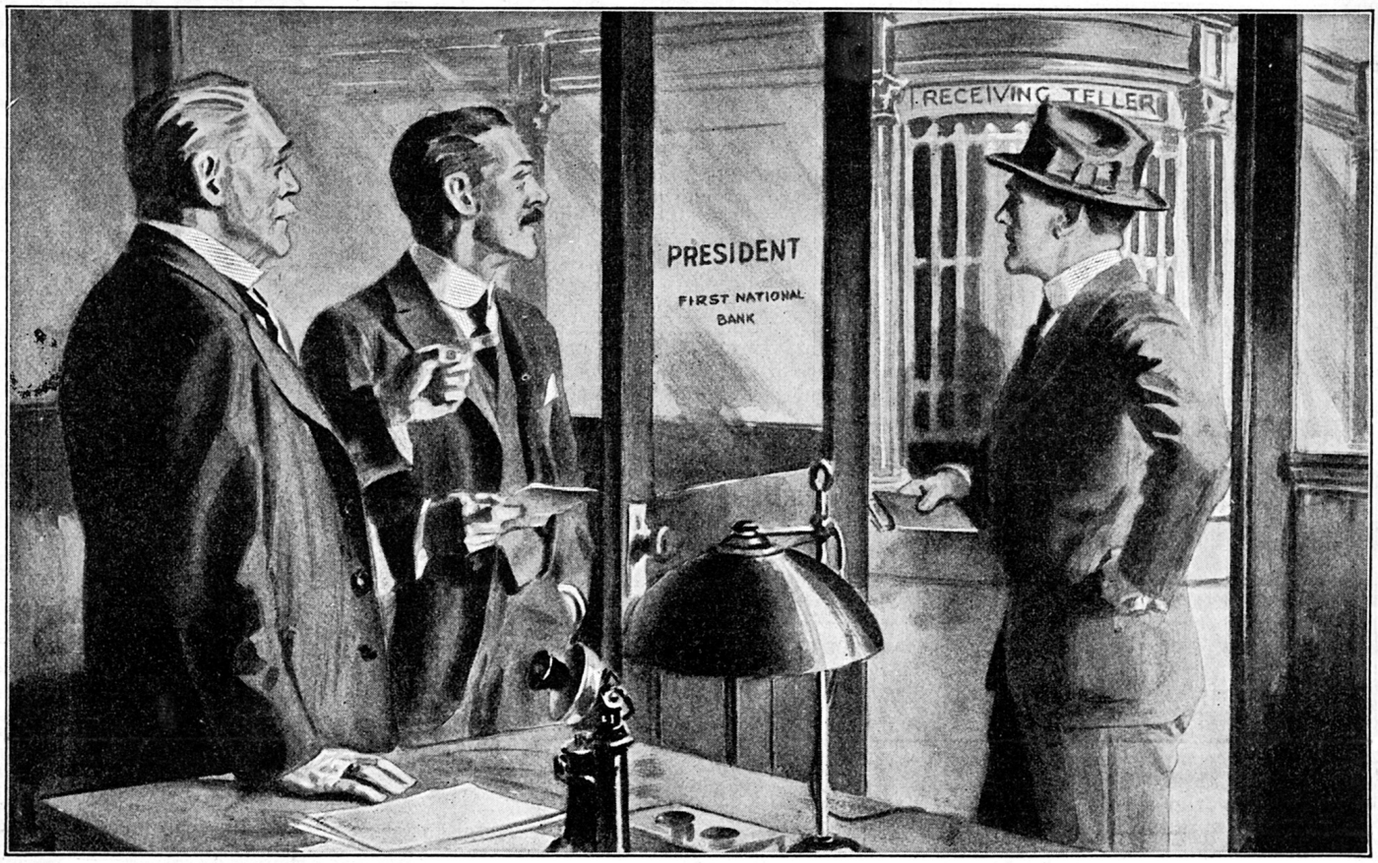
Electroscope Described by the Author and Having Diverging Leaves Made of Aluminum Instead of Gold Leaf. Radioactive Substances Act to Discharge a Charged Electroscope.

contained in Helium and Lead! Einstein has shown in his *Principle of Relativity* that any gram whatever of matter must hold 9.10^{20} ergs, which is to say, *a quantity of energy sufficient to lift ten million tons one kilometer* (.62 mile) *high.*

However, in the case of radio-active transformations the spontaneous disengagement of energy is very slow. It is to be hoped that some day we will know how to accelerate the decay of the atoms and thus utilize the forces they contain; then inversely use this energy to obtain *the entirety* (integration) of matter, which means the inverse phenomenon of radio-activity The man who discovers how to regulate at will the transformation of the elements will assuredly possess "divine power"!

WILL

Mr. S. Le Roy Whitaker, of Topeka, Kansas, kindly communicate with the Editor of this publication as soon as possible!



"He Deposits $500 a Month!"

"See that man at the Receiving Teller's window? That's Billy King, Manager for Browning Company. Every month he comes in and deposits $500. I've been watching Billy for a long time—take almost as much interest in him as I do in my own boy.

"Three years ago he started at Browning's at $15 a week. Married, had one child, couldn't save a cent. One day he came in here desperate—wanted to borrow a hundred dollars—wife was sick.

"I said, 'Billy, I'm going to give you something worth more than a loan—some good advice—and if you'll follow it I'll let you have the hundred, too. You don't want to work for $15 a week all your life, do you?' Of course he didn't. 'Well,' I said, 'there's a way to climb out of your job to something better. Take up a course with the International Correspondence Schools in the work you want to advance in, and put in some of your evenings getting special training. The Schools will do wonders for you—I know, we've got several I. C. S. boys right here in the bank.'

"That very night Billy wrote to Scranton and a few days later he had started studying at home. Why, in a few months he had doubled his salary! Next thing I knew he was put in charge of his department, and two months ago they made him Manager. And he's making real money. Owns his own home, has quite a little property beside, and he's a regular at that window every month. It just shows what a man can do in a little spare time."

Employers are begging for men with ambition, men who really want to get ahead in the world and are willing to prove it by training themselves in spare time to do some one thing well.

Prove that *you* are that kind of a man! The International Correspondence Schools are ready and anxious to help you prepare for something better if you'll simply give them the chance. More than two million men and women in the last 28 years have taken the I. C. S. route to more money. Over 100,000 others are getting ready in the same way right now.

Is there any reason why *you* should let others climb over you when you have the same chance they have? Surely the least you can do is to find out just what there is in this proposition for *you*. Here is all we ask: Without cost, without obligating yourself in any way, simply mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6218, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

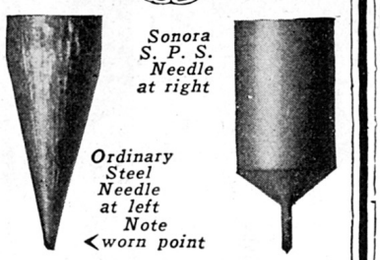
☐ ELECTRICAL ENGINEER	☐ SALESMANSHIP
☐ Electric Lighting and Railways	☐ ADVERTISING
☐ Electric Wiring	☐ Window Trimmer
☐ Telegraph Engineer	☐ Show Card Writer
☐ Telephone Work	☐ Sign Painter
☐ MECHANICAL ENGINEER	☐ Railroad Trainman
☐ Mechanical Draftsman	☐ ILLUSTRATING
☐ Machine Shop Practice	☐ Cartooning
☐ Toolmaker	☐ BUSINESS MANAGEMENT
☐ Gas Engine Operating	☐ Private Secretary
☐ CIVIL ENGINEER	☐ BOOKKEEPER
☐ Surveying and Mapping	☐ Stenographer and Typist
☐ MINE FOREMAN OR ENGINEER	☐ Cert. Public Accountant
☐ STATIONARY ENGINEER	☐ TRAFFIC MANAGER
☐ Marine Engineer	☐ Railway Accountant
☐ Ship Draftsman	☐ Commercial Law
☐ ARCHITECT	☐ GOOD ENGLISH
☐ Contractor and Builder	☐ Teacher
☐ Architectural Draftsman	☐ Common School Subjects
☐ Concrete Builder	☐ Mathematics
☐ Structural Engineer	☐ CIVIL SERVICE
☐ PLUMBING AND HEATING	☐ Railway Mail Clerk
☐ Sheet Metal Worker	☐ AUTOMOBILE OPERATING
☐ Textile Overseer or Supt.	☐ Auto Repairing ☐ Spanish
☐ CHEMIST	☐ AGRICULTURE ☐ French
☐ Navigation	☐ Poultry Raising ☐ Italian

Name_____

Present Occupation_____ 7-26-19

Street and No._____

City_____ State_____



THE INSTRUMENT OF QUALITY
Sonora
CLEAR AS A BELL

Semi-Permanent Silvered
PHONOGRAPH

NEEDLES

THESE needles have parallel sides (not tapered like the ordinary steel needles) and as they wear down they always fit the record grooves perfectly.

These needles are more economical and more convenient than steel needles. They play many times without change, they do away with the necessity of putting in a new needle after playing each record, they sweeten the tone and increase the life of the records.

FREE! A sample needle will be given FREE so that you can prove its merit for yourself. Write for yours today.

Three Grades
Loud, Medium, Soft
25c *per card of* 5 40c *in Canada*

Sonora Phonograph Company, Inc.
George E. Brightson, President
279 Broadway, *Dept. G.*, New York
Toronto: I. Montagnes & Co.

CAUTION! Beware of similarly constructed needles of inferior quality.

LEARN MUSIC WITHOUT A TEACHER

New way. Any instrument you like now made easy. Piano, Organ, Violin, Banjo, Mandolin, Cornet, Harp, 'Cello, Ukelele, Saxophone, Piccolo, Clarinet, Flute, Trombone, Guitar, Harmony and Composition, Viola or Sight Singing, all by note. Don't even need to know one note from another to begin. Lessons by mail in simplified chart and picture form take you step by step, and make every step as simple and clear as A B C. Prepared by foremost musicians. Over 225,000 people, from seven years old to seventy, have learned through these simple lessons. Many have become teachers. This new method succeeds even after old methods of personal instruction fail. Entire course on trial—you to be the judge and jury; averages only a few cents a week if satisfied and nothing whatever if not.

Free book shows how simple and easy it is and gives full information. Special introductory offer if you answer at once. Write today, then judge for yourself. Instruments supplied when needed, cash or credit. No obligation. Address

U. S. SCHOOL OF MUSIC
1332 Brunswick Bldg. New York City

ELECTRIC LAMP BEST FOR MINES.

Nowadays the up-to-date miner carries a package of electricity about with him while underground. It is a small storage battery attached to the back of his belt, and is connected by a cord with a lamp fastened to the front of his cap. The lamp, provided with a reflector, throws a flood of light in front of the miner. But its chief advantage is absolute safety. In olden days miners (who must, of course, have light) carried about with them open-flame lamps. These caused innumerable disastrous accidents thru ignition of coal dust or gases. Sir Humphry Davy's invention of a safety lamp whose flame is protected by a wire gauze saved an immense number of lives.

Practical Chemical Experiments.
—Alcohol

By PROF. FLOYD L. DARROW.

(*Continued from page* 1017)

PROPERTIES AND EFFECTS OF METHYL ALCOHOL.

When pure, methyl alcohol is a clear colorless liquid with a not unpleasant vinous odor. The disagreeable odor usually noticed is due to the presence of impurities. The alcohol boils at about 67 degrees centigrade and burns with a hot, almost colorless flame, making it useful as a fuel. Its great power of solution renders it invaluable as a solvent for varnishes, dyes, fats, oils and resins. Because of its very poisonous properties it is used to denature ethyl alcohol and thus render the latter unfit for use in beverages, altho leaving it unimpaired for many industrial purposes. Such denatured alcohol can be imported duty free.

Taken into the stomach methyl alcohol is a violent poison and its presence in cheap, adulterated whiskies has been responsible for many deaths. Even the fumes from varnishes containing it has been known to produce fatal prostration. Wood alcohol has a peculiar selective action on the optic nerve and doses insufficient to produce death frequently result in permanent paralysis of this nerve and total blindness.

Wood alcohol is capable of producing intoxication similar to that of grain alcohol, but it is somewhat slow in action and its symptoms are of long duration. Fall of bodily temperature is very marked, followed by convulsive muscular movements of a ryhthmic character. There is a loss of sensation and also of the reflex movements of the muscles. The eyes are especially affected. Dilation of the pupil, contraction of the field of vision and a rapid failure of sight result.

The symptoms of wood alcohol poisoning are due to the chemical fact that *in the system it is oxidized to formic acid*, a highly poisonous substance. The similar oxidation of grain alcohol, or spirits of wine, yields acetic acid, the acid of vinegar. In either case the first product of the oxidation is an aldehyd, as is shown in the test for methyl alcohol, but this is followed in the system by oxidation to an acid.

All that can be done in cases of wood alcohol poisoning is to eliminate the alcohol by sweating and to drink large quantities of sodium bicarbonat solution. The bicarbonat will neutralize the formic acid in the system.

"EVADING" THE LIQUOR COP.

Place on the table three rows of tumblers. In the bottom of each tumbler in the first row put a few drops of an alcohol solution of the indicator phenolphthalein. Denatured alcohol may be used in making

(*Continued on page* 1048)

Boys Would you like to earn one of these Magnificent Bicycles absolutely without costing you one cent?

FREE! FREE!

HUNDREDS OF OTHER EXPENSIVE PRESENTS ALSO GIVEN

We have secured an enormous quantity of very beautiful colored pictures, consisting of art, floral, landscape, religious, patriotic, etc., and a very fortunate purchase permits us to sell them at the astonishingly low price of 25 cents each, at which price they are irresistible, and will certainly go fast.

Now all you have to do is to send us your name and address and we will send you 20 of these beautiful pictures, without any charge whatsoever. These pictures you are to sell at 25 cents each. When sold, send us the money, and we will send you goods OF YOUR OWN SELECTION from our 300 page catalog to the value of $4.00. Remember, you get these goods as a premium for selling the pictures and sending us the money. You don't have to pay a cent for them. Many of our agents have sold the whole 20 pictures in one day; some have sold them in the evening. One agent sold six on the way home from the post office, another sold some before he got out of the post office. Another agent sold the entire lot in one house. People are wild to get these pictures once they see them, and you will have no difficulty in disposing of them if you will only show them. Remember, you have our entire catalog to select your premiums from, and there are hundreds of presents such as Air Rifles, Guns, Moving Picture Machines, Musical Instruments, Cameras, Telescopes, Printing Presses, Typewriters, Books, Puzzles, Games, Tricks, Toys and Novelties, Rubber Stamps, Household Labor-Saving Devices, etc., many of them unprocurable elsewhere, and we are sure you would like to get many of them, especially if you can do so without having to pay any money for them.

By continuing the sale of our pictures you can earn the magnificent Bicycle illustrated. We will give you $4.00 worth of presents for every 20 pictures you sell. Send in your application at once, and we will send you the first lot of pictures immediately, accompanied by our big catalog of over a thousand different articles to select your premiums from. You don't have to send any money. We trust you absolutely.

Johnson Smith & Co., Dept. E7, 3224 N. Halsted St., Chicago

The Electric Safety razor makes shaving a pleasure. Blade vibrating 7,200 times a minute cuts the beard smoothly and without slightest pull or irritation—feels like a gentle massage. Can be used with or without electric current.

All users of the Lek-Tro Shav speak well of it

A barber says—"Have shaved for years and have never used any shaving device near its equal."

A home user says—"The most pleasing shave I've ever had in my life. Shaves my face closer than I used to shave, but there is no after irritation or ill effects as I usually get from another razor."

No. 1 Made for use from Light Socket.
No. 2 Made for use from Dry Battery.

Write for illustrated circular describing Lek-Tro-Shav Safety Razor fully.

VIBRATING ELECTRIC RAZOR CO.
Dept. 122, Omaha, Nebr.

INVARIABLY

Four-months-for-a-dollar subscribers renew their orders for

THE PHOTO PLAY WORLD

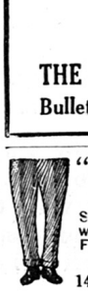
because they find this high class publication indispensable for their library every month.

If you are not a regular reader, a dollar will bring you the next four numbers, each bigger and better than ever. When your subscription has expired you'll want the Photo Play World regularly.

The yearly subscription is $3.50—35 cents on newsstands.

Sample copy on request.

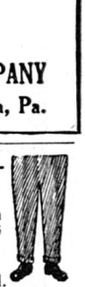
THE DOWNS PUBLISHING COMPANY
Bulletin Building Philadelphia, Pa.

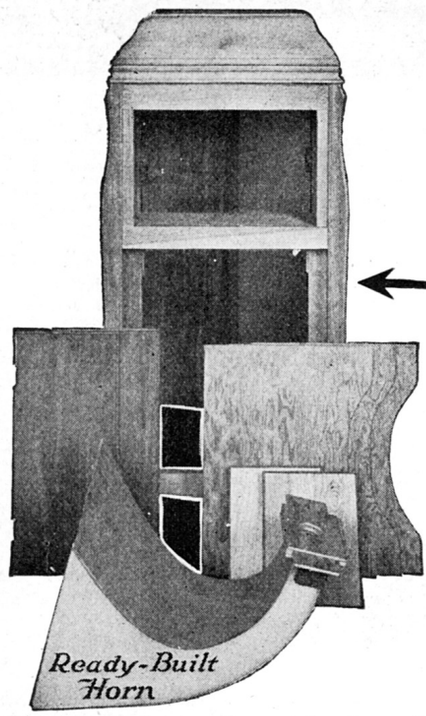


"BOW LEGS and KNOCK-KNEES" UNSIGHTLY

Send for booklet showing photos of men with and without THE PERFECT LEG FORMS.

PERFECT SALES CO.
140 N. Mayfield Ave., Dept 50, Chicago, Ill.





The Cabinet pieces, as you receive them, all ready for assembly and finishing, according to plan 3. Also furnished, "knocked-down," plan 2, and for cabinet makers, plan 1, to be worked out from simplified plans and blue prints, which we supply.

The Cabinet Pieces consist of legs, shelves, doors, scroll, dome strips, panels, ready-built tone chamber, and all other pieces ready to assemble and glue together. No cutting, no fitting, no special tools required. The Cabinet in the White, so styled by our information literature, are the cabinet pieces all assembled and glued together. There remains only for you to install the motor and tone arm, attach the cabinet hardware and do the finishing. This is our Plan 3, and is very popular, as it calls for the least amount of mechanical work, and is more quickly done.

This Shows How *Easy* We Make It For You To BUILD YOUR OWN PHONOGRAPH

LOOK at the cut at the left, and you will quickly see how easy we have made it for you to build your own Phonograph, in your own home, kitchen, basement, or, out in the garage, after you receive the cabinet pieces, all cut, fitted, all ready to go together according to our plan.

You Don't Need to Be a Cabinetmaker

to do the job. All the hard part has been done. No chance for mistakes. After it is all set up and the Tone Arm and Motor are in place, it will be another simple matter to finish it in the color you wish. You will enjoy the work immensely.

Read What This Ohio Man Says:

"I have found it no trick at all to build your Model 5. . . . Would not trade it for any selling around $200.00 in the stores . . . . I am going into the business of building Phonographs to sell my friends."

You can do what he did, and have a beautiful machine at a

Tremendous Saving in Cost

if you will do as we say—send for the cabinet pieces and do a little pleasant work, in spare time, at home.

The family will enjoy the phonograph as much as you, and all will be prouder of it because you made it—*Built It Yourself.*

You do not have to confine yourself to any one model. There are

Six Models to Choose From

all handsome, offering you a wide range in price. The mechanical parts are the same in quality for all models and consist of motor, sound-box, tone-arm, turn-table, winding crank, speed regulator, brake, etc. No machine at any price has any finer mechanical equipment than these. They play all records.

Agents Are Making Big Money

How? *Making and selling Phonographs on our plan!* Naturally they can sell much cheaper than the retailer, and the demand is always greater than the supply. Soon a man has to devote all his time to HIS OWN BUSINESS.

He has entered *the manufacturers class,* and become engaged in one of the best businesses on earth—the musical instrument business, and by starting small, he can grow, and furnish his own capital. We help him with his manufacturing and merchandising plans, at every stage. There is not sufficient room here to give the particulars of the whole interesting plan, but we will do so if you will

SEND COUPON TODAY FOR FULL PARTICULARS

and read them carefully. They will open up a new business to you, as well as show you how you can build a phonograph for yourself, at a tremendous saving in cost—*fully one-fourth.* Send that coupon right away, while the subject is fresh in your mind.

MODERN PHONOGRAPH SUPPLY COMPANY

200 Springer Bldg. **313 S. Clinton St., Chicago, Ill.**

FILL OUT THIS COUPON AND MAIL TODAY

MODERN PHONOGRAPH SUPPLY CO.

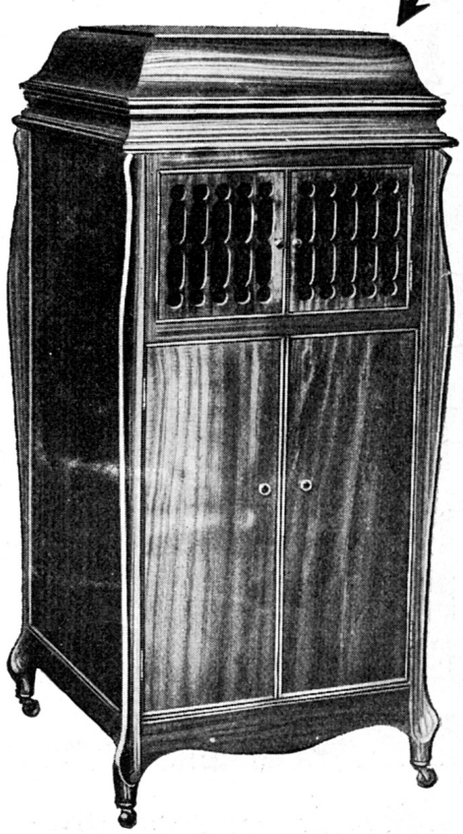
200 Springer Bldg., 313 S. Clinton St., Chicago, Ill.

Gentlemen:—Please send me full particulars of your "Build Your Own Phonograph" proposition, without obligation to me.

Name .....

Street Address.....

City or Town.....State.....



This is the finished product, model 5, that one of our patrons built himself, from our Cabinet Pieces, and mechanical parts, etc., at about one-fourth retail price asked for a machine of like quality.

One Hour a Day Will Raise Your Pay

MORE money! Isn't that the ambition of all of us? Isn't it YOUR ambition? The things you can do with money make life worth living—help you buy such luxuries as a home of your own, a car, better clothes, and have money in the bank. The mental satisfaction of making big money is a luxury itself. It gives a man confidence and pep to know that he has the ability to command big pay. To "make more money" is both a natural and healthy ambition—one you can accomplish *any time you are ready.*

Your ambition to hold a better job, to earn bigger pay, can be fulfilled when you realize that salaries are paid on a C. O. D. basis. Your pay check is a cold-blooded indication of what you can deliver. Therein lies the key to satisfying your ambition. DELIVER MORE. Your boss won't take the time to improve your delivery to him. That's up to you. When you can deliver more you'll find employers eager and willing to bid for your services. So many can deliver but a part of the requirements that there is naturally a big market for the man who is above this class—**the man who can think and act for himself.**

Set aside one hour a day to raise your pay—one hour that will not interfere with your work or pleasure—one hour that does not now earn you a cent. Designate in the Coupon below the work in which you would like to earn more money and we'll show you how to do it, without risk or obligation on your part.

American School of Correspondence
Dept. E-262 Chicago, U. S. A.

TRAINING—THE KEY TO SUCCESS

Explain how I can qualify for the position checked. ASC

.....High School Graduate	.....Lawyer
.....Electrical Engineer	.....Business Manager
.....Electric Light and Power Superintendent	.....Certified Pub. Acc'nt
	.....Accountant and Auditor
.....Hydroelectric Engineer	.....Bookkeeper
.....Telephone Engineer	.....Stenographer
.....Telegraph Engineer	.....Fire Insurance Expert
.....Wireless Operator	.....Sanitary Engineer
.....Architect	.....Master Plumber
.....Building Contractor	.....Heating and Ventilating Engineer
.....Civil Engineer	.....Automobile Engineer
.....Structural Engineer	.....Automobile Repairman
.....Mechanical Engineer	.....Airplane Mechanic
.....Shop Superintendent	.....Gen'l Education Courses
.....Steam Engineer	.....Common School Branches
.....Draftsman and Designer	

Name.....

Address.....

.....

FACTORY-TO-RIDER SAVES YOU MONEY

Buy direct and save $10 to $20 on a bicycle. **RANGER BICYCLES** now come in 44 styles, colors and sizes. Greatly improved; prices reduced. **WE DELIVER FREE** to you *on approval* and *30 days trial*, actual riding test.

EASY PAYMENTS if desired, at a small advance over our Special Factory-to-Rider cash prices.

TIRES, lamps, wheels, parts and supplies at *half usual prices.*

Do not buy a bicycle, tires, or sundries until you get our big free **Ranger** catalog, low prices and liberal terms. A postal brings everything.

Ranger Electric Lighted Motorbike

MEAD CYCLE COMPANY Dept. M-107 Chicago

KNOW COSTS **ACCOUNTANCY**

Be a Cost Expert. Earn $5,000 to $10,000 yearly. C.P.A.'s teach you thoroughly in a few months by our New Home study system. Low Cost—FREE BOOK. International Accountants Society, Dept. 39N 1526 S. Michigan Ave. Chicago

Practical Chemical Experiments

(*Continued from page* 1046)

the solution. Cover the bottom of each tumbler in the second row with *strong* sulfuric acid. Likewise cover the bottom of each tumbler in the third row with a strong solution of caustic soda.

Fill a pitcher with clear water and add one or two tablespoonfuls of household ammonia. Stir thoroly.

Now announce to your audience that you are going to pour wine from a pitcher of water, at the same time filling the first row of tumblers. The ammonia and the phenolphthalein immediately react, giving a beautiful wine color and yet you are pouring into apparently empty tumblers.

Then suppose you spy the "Federal liquor officer" and wish to destroy the evidence of beverages of more than one-half per cent of alcohol. Pour the "wine" into the second row of tumblers and it will at once change into water. The acid destroys the ammonia and removes the color.

When the "officer" has gone and the danger is past, pour the decolorized "wine" into the third row of tumblers and the wine will reappear. The caustic soda reacts with the phenolphthalein to give the color again.

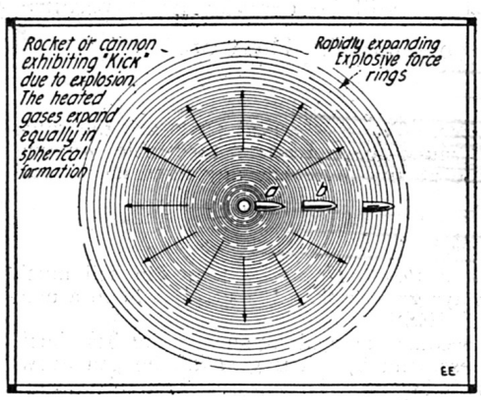
No more striking set of color changes than this can be seen on the stage.

The preparation of pitcher and tumblers are of course made in advance of the demonstration.

The Goddard Moon Rocket

(*Continued from page* 988)

the rocket takes only a few minutes to make its ascent and descent.



If an Explosion Occurs the Force Expands Rapidly in Rings as Shown, Causing a Movable Body to Exhibit a "Kick" or Movement Along the Line A-B.

The Possibility of Reaching the Moon.

From his findings Dr. Goddard claims that reaching such extreme altitudes as 2,310,000 feet (437 miles) is not at all improbable provided that the efficiency is high. Theoretically a body shot from this earth and traveling at a rate of 6.95 miles per second would never return. This was illustrated in the article by Mrs. Isabel Lewis in the September issue of this magazine.

Consider now that instead of an initial velocity which must die down due to air resistance, overcoming the gravitational pull of the earth, Dr. Goddard claims that if the energy is being supplied constantly there should be no difficulty in reaching even such bodies as the moon, and exploding there the effect could be noted thru a telescope.

How to Become A Master of English

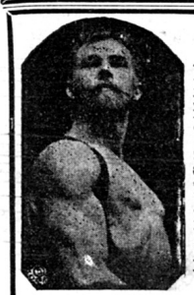
is a valuable FREE booklet which *proves* that the Kleiser Mail Course in Practical English and Mental Efficiency will teach you to *Write Stories that Sell—Literature that will Compel Attention;* it will show you how to *Enlarge Your Stock of Words—Use the Right Word in the Right Place—Prepare Sermons, Addresses, Advertisements, Letters, etc.*

BOOTH TARKINGTON
Distinguished Novelist:

"Your Course is almost painfully needed by many professional writers and speakers. A student who intelligently follows your Course will know what he is talking about when he talks or when he writes."

Famous Writers, Business and Professional Men, Speakers, and others are sending enthusiastic letters telling how the Course has enlarged their mental capacity, increased their incomes. It will do the same for YOU. Send TO-DAY for the FREE booklet to

FUNK & WAGNALLS COMPANY
Dept. 357 New York, N. Y.



LIFE'S BACKBONE

Get This Free Booklet

You need it right now if you haven't the pep-punch-ambition you should have. If you are irritable—nervous—unable to concentrate; if you suffer from dizzy spells — insomnia — headaches — rheumatic or other pains—constipation—indigestion—sore muscles—depression. It describes my world famous system of Condensed Exercise, and tells how you can win to robust, vigorous manhood through the use for ONLY TEN MINUTES EACH DAY of my wonderful invention

AUTOMATIC HEALTH EXERCISER

Scientifically built. You can actually watch yourself grow in strength from day to day. Helps you attain a superb physique—you can double your present strength. Learn to live right! Get all the happiness and joy there is in life! Life's Backbone points the way. It's FREE. Send for it now.

Prof. A. P. Schmidt, 1953 Broadway, New York City

GLIDE "O" PLANE

Learn the principles of Aviation by flying our famous glide O plane. Not a toy, but a scientifically constructed gliding model, which may be thrown by hand on the field or launched from the top of the hill. Will circle, loop and glide gracefully with a light throw. Constructed of best materials, finished in Bright colors with the insignia of the U. S. Army on the Main Plane. Very durable and easy to fly. All wood, adjustable. Price 55c Postpaid in U. S. Send for catalogue H3.

HEC Aeroplane Co., 345 E. 49th St., New York City

Big Profits Every Month in Battery Charging

You Can Make Big Profits in BATTERY CHARGING

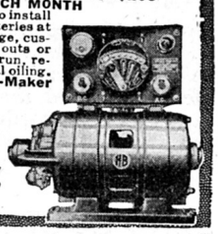
Owners of HB Chargers everywhere are making $100 to $350 Clear Profit every month. YOU can do as well. Don't delay. Get out and get this business with sturdy dependable HB Equipment.

This HB 500 Watt Charger Will Pay $100 to $200 CLEAR PROFIT EACH MONTH

No electrical knowledge required to install or operate. Recharges 6-volt batteries at once. Costs 10c to 15c each to recharge, customer pays 75c to $1.50. No burn outs or expensive renewals. Economical to run, requires no attention, save occasional oiling.

Small Payment Puts This Money-Maker in Your Garage

Balance in easy monthly payments. Earnings easily pay for machine. Send today for full information. Sold under HB ABSOLUTE MONEY BACK GUARANTEE. Order NOW. Get busy! Get those Profits!



HOBART BROTHERS COMPANY
Box 22E Troy, Ohio
Successful Mfrs. Since 1893

Learn Shorthand, 5 Hours

You will be amazed at the ease and quickness with which you learn the wonderful K. I. Shorthand. In a few hours you'll know the whole system and can then gain speed in taking down dictation, conversation, speeches, orders, etc., as fast as a person talks. A free lesson will be mailed by King Institute, EB-300, Station F, New York, N. Y. Just write for this and see how easy you learn. Astonish everybody with your ability, and earn more money.

Learn Autos and Tractors

Wonderful opportunities constantly offered trained men; we train you thoroughly to start your own business or make good money as motor expert, driver, shop foreman, etc.

5000 Graduates making good. Catalog Free.

Cleveland Automobile School, 1807 E. 24th St., Cleveland, O.

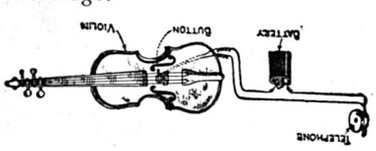
SKINDERVIKEN TRANSMITTER BUTTON

MOST SENSITIVE MICROPHONE

FOR $1.00

YOU can easily make a highly sensitive detectophone by using a Skinderviken Transmitter Button to collect the sound waves. You can build your own outfit without buying expensive equipment. Think of the fun you would have with such an instrument! It's very simple, too, and inexpensive.

You can install an outfit in your home and hear the conversation being held all over the house. You can connect up different rooms of a hotel. *This outfit was used by secret service operatives during the War. It is being used on the stage.*

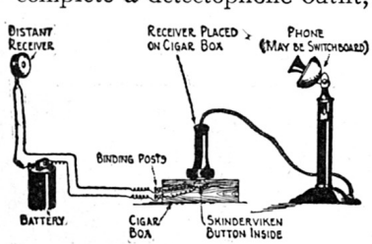


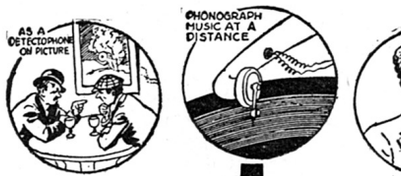
So much for its commercial adaptations! *You* can procure apparatus of the same type.

One of the main advantages of the Skinderviken Transmitter Button lies in its ultra-sensitiveness. You can place it in any position you like. It is the greatest invention in micro-phones and has won recommendations from men of high standing in the scientific world. It is being used all over the world. You can mount it most anywhere. Card board boxes, stove pipes, stiff calendars and hundreds of other places will suggest themselves to you. The buttons cannot be seen by any one in the room as they are so small and light. Only a small brass nut is exposed to the view.

Full directions for connecting up the button for use as a detectophone are given in booklet which is sent with each button.

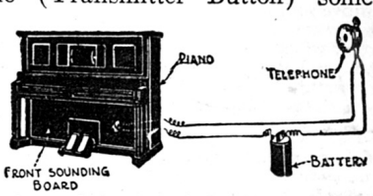
The only instruments needed to complete a detectophone outfit, in addition to a Skinderviken Transmitter Button are a receiver, battery, and, if desired, an induction coil.





AMONG electrical experimenters the button has created a sensation. It is not uncommon to receive unsolicited letters like these: "I received transmitter button today and I wish to inform you that it works great and is *the best I have ever seen or heard of for the price.* I will certainly recommend it to my friends. I wish to thank you for your good service."

"I have been using one of these transmitter buttons, and it has proved to be worth more than its value in my experimenting." "I received one (Transmitter Button) some time ago, and they are just O. K. for experimenting." "I have been using one of these transmitter buttons for experimental work and it certainly lives up to all you say for it *and then some.*"

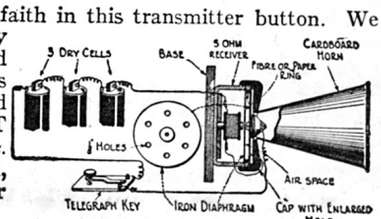


Mr. H. Gernsback, editor of this magazine, who is the dean of electrical experimenters, said: "In the writer's opinion, obtained by actual elaborate tests, the Skinderviken Transmitter Button is probably the most efficient device of its kind on market today, due to its simplicity and other outstanding features. Should have a great future."

The same circuit connections apply to all experiments, regardless of how the transmitter button is mounted.

The Skinderviken Transmitter Button operates on one or two dry cells. It often happens that two cells produce too much current and the sounds are deafening. We recommend either one fresh cell or two worn out cells.

We have the utmost faith in this transmitter button. We guarantee satisfactory service or we will refund the purchase price. Boys—Young and old—send in a dollar bill RIGHT NOW! You can't lose. If you're not satisfied, you receive your dollar back. Isn't that fair?



JOHNSON SMITH & CO., Dept. E-14, 3224 N. Halsted Street, Chicago

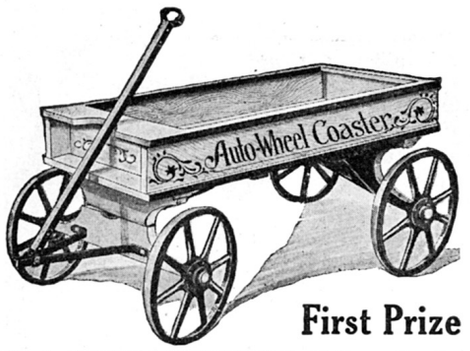
USE THIS COUPON

Johnson Smith & Co., Dept. E. 14, 3224 N. Halsted St., Chicago, Ill.

Gentlemen:—Please ship at once to address below.....Skinderviken Transmitter Buttons for which I enclose $.....

Name .....

Address .....City .....State.....



First Prize

Won By SCOUT KENNEDY PEIRCE, Tr. 63, Kansas City, Mo.

The judges decided that Scout Peirce's contest letter contained the sixteen best uses for the Auto-Wheel Coaster.

His Prize is the Auto-Wheel Coaster Itself.

The Other Prizes Were Awarded as Follows:

2nd. Tent, Henry Jacobs, 37 Watkins St., Brooklyn, N. Y.
3rd. Poncho, Frederick M. Folger, - - - - Easley, S. C.
4th. Fleetwing Racer, Jas. O. Pierce, - West Plains, Mo.
5th. Camera, E. B. Roensch, Dooley Bldg., Houston, Tex.
6th. Mess Kit, W. Hayward, 603 Cross St., Ypsilanti, Mich.
7th. Flashlight, Jas. A. Bishop, Route 12, Knoxville, Tenn.
8th. Knife, Arthur Rick, 223 Mariposa St., Syracuse, N.Y.
9th. Scout Axe, Joseph Gerend, Box 76, S. Kaukauna, Wis.
10th. Watch, Albert Schulte, - - Box 364, Houghton, Mich.
11th. 3-Coin Bank, Stuart Demarest, - Roselle Park, N. J.
12th. Scout Compass, Charles E. Brady, - - Glen Ellyn, Ill.

There will be several more Auto-Wheel contests this year. Watch for the announcements. Get the Auto-Wheel Booklet now. Send us the names of three local coaster dealers, mentioning which one handles Auto-Wheel. We'll send you a handsome *Felt Pennant FREE.* and our attractive booklet. Ask us about the Auto-Wheel Clubs—how to get special Caps for the members.

BUFFALO SLED COMPANY,
153 Schenck Street,
N. TONAWANDA, N. Y.
In Canada: Preston, Ont.

WE'LL USE IT AGAIN

Rider Agents Wanted

In every neighborhood to ride and exhibit a sample RANGER bicycle furnished by us. Choice of **44 styles,** colors and sizes in the famous **Ranger** line. Mead Rider Agents make big money in spare time hours—after school or work.

30 Days Free Trial
Is allowed on every RANGER bicycle. We **prepay** freight charges. If not pleased the trial costs you nothing.

Factory-To-Rider
We sell bicycles made in our own big factories **DIRECT TO THE RIDER**—giving you **a superior** product at greatly reduced cost. Save time, money and trouble by dealing **direct** with our great Factory organization. Satisfaction in every detail guaranteed or money promptly refunded.

EASY Payments Nine months to pay if desired — at a small advance over our special cash prices.

TIRES Lamps, Wheels, parts and supplies at half usual prices are also fully described and illustrated in the big **free** Ranger Catalog. **SEND NO MONEY,** but write us **today** for factory prices, liberal terms and if desired Rider Agents Plan.

MEAD CYCLE COMPANY Dept. M.-107 Chicago

Send for This Book of Model Aeroplanes

Tells how you can build and fly accurate, reduced-scale Models of real Aeroplanes; DE HAVILAND Battle Plane, NC-4 and others. You can build one easily. Send 10c in stamps NOW and get this 48-page book. **Plans for Model Aeroplanes**—NC-4, 50c; DE HAVILAND Battle Plane, Curtiss Military Tractor, Bleriot Monoplane, Nieuport Monoplane, Taube Monoplane, 35c each; Cecil Peoli Champion Racer, 25c.

SEND FOR PLANS OR BOOK TODAY

IDEAL AIRPLANE & SUPPLY COMPANY
Making Model Aeroplanes Since 1911
159-161 Wooster St., Cor. W. Houston St., New York

Suspended Gravitation

By H. GERNSBACK

(*Continued from page* 992)

descending to the earth like a parachute.

What is the practical object of this invention? Thousands of new uses will be found for it. All our homes and our offices will be equipt with the invention, and the immediate important result will be no doubt *greater longevity of human beings.* The wear and tear on the muscular and nervous systems due to the weight of our bodies is tremendous at present, all of which tends to shorten our lives. Remove the cause and we immediately become more or less rejuvenated.

In our illustration 5, I have shown several applications of the invention in which it will be seen that the persons or objects are all screened from the earth's gravitation. In sketch 1 we see a badly wounded patient in a hospital with his legs extended. He certainly will never be bed-ridden, and he will not become chafed because there is nothing to chafe against. Patients, particularly, will find the new invention of tremendous boon and they will all recover ever so much sooner. Our patient could sleep in any position and his sleep will be refreshing. He will not be smothered either by having his body pressing against an uncomfortable mattress. If he wishes to change his position, he uses the vertical hand rail as shown. He can move his body up or down and with practically no effort. Of course a well man would not need such a rail because by giving quick jerks, he could move from one position to another, but a sick person could not do this. Our patient's leg, too, remains in the exact position as ordered by the doctor.

Scene 2 shows a locomotive factory, where a weightless locomotive is being assembled without the use of electrical cranes or ponderous machinery. The huge six-foot wheels and the heavy piston case weigh nothing, and can be moved about and handled with the greatest ease. A locomotive will be assembled in one quarter of the present time by workmen who will not perspire in performing the job and who will not go home with "broken" backs due to the strenuous work. Work then will become a pleasure and a locomotive will be turned out in one quarter of the time at one tenth the labor expense it took heretofore.

Scene 3 shows a factory girl assembling various devices. It immediately becomes apparent that a very small space suffices for her work. *No longer is she restricted to one plane* as the present day working table. She could work in a dozen different working planes if she desires. The finisht boxes are at her left and the work she is doing is placed around her wherever it is most convenient. She does not have to reach and stretch as much as before, and being that things are right where she wants them, and furthermore because *her bodily movements no longer tire her,* she will become extraordinarily efficient, and will turn out ten or twelve times as much work as she did heretofore. No longer will she go home with a back-ache from physical exertion. She will go home refresht from her day's work, as is apparent.

Scene 4 shows our friend the typist in her office. Here too, work has become mere play. The confusion of the objects is only apparent. The things are just where they are needed and within easy reach. Everything is just where it should be and she can write in whatever position suits her best. She can either recline, or should she desire it, she could stretch flat on her back with her typewriter above her. Or if she is particularly eccentric, she can lie

(*Continued on page* 1052)

EARN REAL PHONOGRAPH

Beautifully finished, nickel winding crank, spring motor, speed regulator, stop lever. New improved sound box with mica diaphragm—makes perfect reproductions of all kinds of music. A marvelous machine in every way. Delighted thousands of homes.

SEND NO MONEY

Just your name, and we will send you 24 of our Art Pictures to dispose of on special offer at 25c each. Send us the $6 you collect and we will send this new improved E. D. L. Phonograph and a selection of 6 records free.

E. D. LIFE, Dept. 1T82 CHICAGO

Sick, Weak, Run Down?
THE KNEIPP CURE

A wonderful book by Rev. Mgr. Sebastian Kneipp; will help you to get well. Gives treatment for all the diseases this marvelous method of natural curing has helped.

$1.60 Paper Covered. $2.10 Cloth Bound, Postpaid.

Dr. Benedict Lust, 110 E. 41st St., N. Y. C.

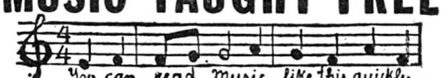
CLEARTONE PHONOGRAPHS
$4.00 to $200.00 Retail

Needles 45c per thousand in lots of 500,000 Motors $1.35 to $14.75 each. Tone Arms and Reproducers $1.30 to $5.75 per set. Main Springs 20c to 90c each. Records, Needles, Sapphire Points and Parts at reasonable prices.

Write for our 84 page catalogue, the only one of its kind in America, illustrating 33 different styles of Talking Machines and over 500 different Phonographic Parts.

LUCKY 13 PHONOGRAPH COMPANY
Export Dept. 46B E. 12th St., N. Y., U.S.A.

MUSIC TAUGHT FREE



In Your Home. Write today for our booklet. It tells how to learn to play Piano, Organ, Violin, Mandolin, Guitar, Banjo, etc. Beginners or advanced pupils.

American School of Music, 57 Lakeside Bldg., Chicago

GO INTO MOVING PICTURE BUSINESS
Small Capital Starts You
on our easy payment plan. Begin now and get your share. We sell everything. Write today.
Our Catalog FREE. Shows you how to earn $25.00 to $50.00 per day
Atlas Moving Picture Co.
Dept. 50 538 S. Dearborn St., Chicago

How to Get Rid of Moles

A simple, safe home treatment—15 years' success in my practice. Moles (also BIG growths) Dry Up.

Ask for Free Booklet of Full Particulars

WM. DAVIS, M.D.
4140 State Street Perth Amboy, N.J.

The ROGERS
Violet Ray, High Frequency Generator
Does not burn out. No sparking—therefore all shocks are eliminated. An ideal outfit, fully guaranteed as to material and workmanship.

PRICE COMPLETE With One Surface Applicator **$25.00**

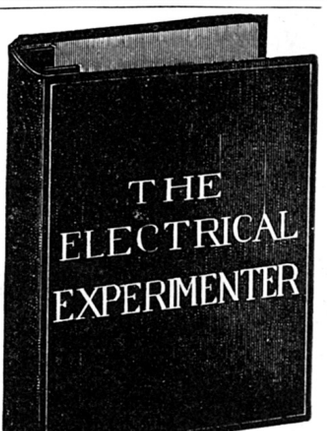
Send for free descriptive Booklet

The Rogers Electric Laboratories Co.
Dept. B, 2056 E. 4th St., Cleveland, Ohio

Handy Binder

For the Electrical Experimenter

Holds and preserves 12 issues, each of which can be inserted or removed at will, without tools. Made of heavy material, extra reinforced at the back.



65c

Add postage for 2 lbs.

Experimenter Pub. Co. Inc. *Book Dept.* 233 Fulton St., N.Y.

He Earns $50 a Week Repairing Autos

THOUSANDS of men everywhere are doing the same. Many are getting more than this. Some are opening garages of their own. Why don't you get into the auto game too? Men in other lines with a little mechanical ability have doubled their earnings after getting into the fascinating field of auto construction and repairing. Ten times the number of men now engaged in the business are needed. Fine, big paying jobs are waiting for men who "know" to fill them. Read below and find out how you can fit yourself to hold one of these big, man's size jobs in your spare time, without going away from home at a cost of only 7c a day.

Learn at Home

No need to pay for an expensive course that will take you away from home. You can learn the auto game at a cost of one-tenth the expense of going away to school. You don't have to serve an apprenticeship either. Use spare time only and keep right on with your present work. This Library of Automobile Engineering and Tractor Information will make an expert out of you and fit you for the biggest kind of job. It is in six thick volumes, with 2600 pages and 2300 pictures, plans, diagrams and blueprints, etc. Every part of every well known car is explained. They teach you everything the best auto schools teach.

Fifteen great auto engineers prepared these money-making books for men like you. You don't have to know a thing about cars to understand them. Every page is written in plain, everyday language and they begin right at the beginning. With every set we give FREE a consulting membership in our society. You can write our engineers any time and get their help on any proposition on which you get stuck.

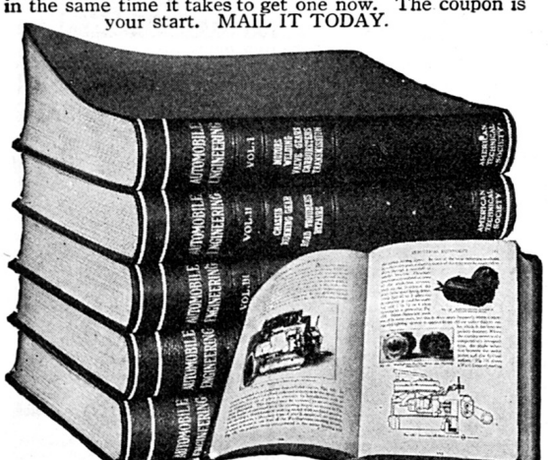
FREE Examination!

Mail the coupon for free examination. Don't send any money. We will ship the books (all 6 volumes) by express collect and you can have a whole week to use them as if they were your own. Give them every test you can think of. Take them to your shop. Show them to your friends and ship them back at our expense if you don't want to keep them. If you do keep the books to help you earn more, send us only $2.80. You can send the balance of the $21.80 price the same way—$2.00 each month. Only 7 cents a day. This is your chance to double your earnings—earn two dollars in the same time it takes to get one now. The coupon is your start. MAIL IT TODAY.

Everything About Autos

Automobile Motors; Welding; Motor Construction and Repair; Carburetors and Settings; Valves, Cooling; Lubrication; Fly-Wheels; Clutch; Transmission; Final Drive; Steering; Frames; Tires; Vulcanizing; Ignition; Starting and Lighting Systems; Shop Kinks; Commercial Garage Design and Equipment; Electrics; Storage Batteries; Care and Repair of Motorcycles; Commercial Trucks; Gasoline Tractors.

128 Blueprints of Electric Wiring Diagrams



Don't Send Money— Just Mail This Coupon

American Technical Society :: Chicago

AMERICAN TECHNICAL SOCIETY
Dept. A-252, CHICAGO, U. S. A.

Please send me the 6-volume set of Automobile Engineering for 7 days examination, shipping charges collect. If I decide to buy I will send $2.80 within 7 days and balance at the rate of $2.00 a month until $21.80 has been paid. Then you will send me a receipt showing that the set of books and the Consulting Membership are mine and fully paid for. If I want to get along without the books, I will notify you after 7 days to send for them at your expense.

Name.....

Address.....

City..... State.....

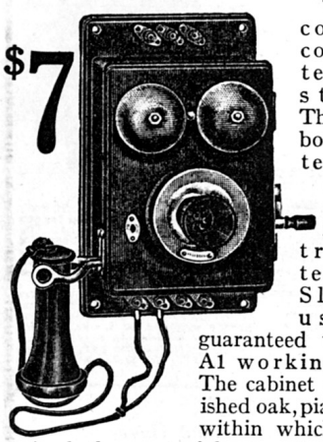
Reference.....

Please Fill Out All Lines

For Homes, Offices, Factories, Farms

Complete Wall Set Magneto Telephone

Western Electric Type



$7

This is a complete commercial telephone station. They were bought from telephone exchanges who put in Central battery types. Slightly used but guaranteed to be in A1 working order. The cabinet is of polished oak, piano finish, within which is contained the powerful magneto, the 300 Ohm polarized ringer, and induction coil. The magneto is exceptionally efficient, being of the two bar type with brass gear transmission. The extra sensitive microphone, mouthpiece and two gongs are mounted on the front of the cabinet, giving the entire instrument that desirable appearance of compactness and efficiency. Guaranteed to work over 20 miles. The telephone receiver is a double poled one, and has a hard rubber case. Seven binding posts are provided for connections.

The instrument is one which we can offer with pride to our patrons at a ridiculously low price. It is unobtainable anywhere else at less than $15.00 and is an instrument unequaled in value for the price we ask. Size over all 11x10x8 in.

Long Distance Telephone Set—
One station..... $7.00
Shipping weight, 15 lbs.

Two stations..... $13.00
Shipping weight, 25 lbs.

Send 6c in stamps for our big 176 page Wireless and Electrical Catalog No. 21.

The Electro Importing Co.
231 Fulton Street, New York

FREE SEND NO MONEY WE TRUST YOU

We are giving away thousands of dollars worth of valuable presents, such as Watches, Sterling Silver Initial Water Sets, Air Rifles, Guns, Moving Picture Machines, Musical Instruments, Cameras, Printing Presses, Typewriters, Telescopes, Books, Puzzles, Games, Tricks, Toys and Novelties, Rubber Stamps, Household Labor Saving Devices, etc. All you have to do is to send your name and we will send you, without any charge, 20 extra large De Luxe colored pictures, to sell at 25c each. When sold, send us the ($5.00) and we will give you goods of your own selection to the value of $4.00 from our wonderful 300 page premium catalog. Remember, you get these goods as a premium for selling the pictures and sending us the money. You do not have to pay one cent for them. By continuing the sale of our goods you can earn a magnificent bicycle and many other expensive presents. We are a large and responsible concern, having a million customers on our books. Our goods have been extensively advertised in "Popular Mechanics" and all the leading magazines for many years. You can have your choice of $4.00 worth of these goods, and by our method we actually provide you with the means of purchasing these valuable presents. Send in your application at once, stating whether pictures or postcards are preferred, and we will immediately send you the first lot, accompanied by our big catalog to select your premiums from.

JOHNSON SMITH & CO.,
Dept. E6, 3224 N. Halsted St., CHICAGO

Suspended Gravitation

By H. Gernsback

(*Continued from page* 1050)

with her face towards the floor and the typewriter beneath her! It all depends upon her head-ache, in whichever position she is most comfortable! The strap suspended in front of her is simply for her convenience as is the guard rail at her side. By these she can move into any position she wants to without jerking herself about or without touching the floor. Of course, she will turn out more letters than ever, and there will not be any three o'clock afternoon fatigue. One thing we must mention and that is that this typewriter must not be of the gravity type where the keys *fall* back by themselves. Such a typewriter would not work here. The typewriter must be one that has springs attached to the key levers to pull them back into the original position. Another thing and this is quite important, she must not bang the keys too hard because if she did the typewriter would "swim" away and hit the floor! This would make for a light touch! Perhaps she would find that after all the typewriter should be held by strings or cords, otherwise she would have to chase it all over the place!

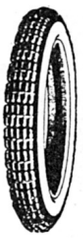
Scene 5 shows how the heaviest of safes is moved readily by the smallest of "flivvers," simply by having an electrified net underneath the safe, which serves to cut off the earth's gravitational effects. In order that the safe is not blown away by the wind—you see it weighs nothing,—ropes or chains hold it to the truck. The automobile furnishes the electricity to electrify the net, and if our driver is wise he will carry an electrified net in front of the machine as well. Then if he runs into the stout party as shown, she will not be thrown violently against the hood of the flivver, but will remain suspended immediately in front of the auto without coming to grief; even if the wind blows her against the hood of the auto, little harm will be done to her, because you see altho nominally weighing 269 lbs., she now weighs nothing, hence has lost practically all inertia. A little bump therefore will hardly be felt.

Scene 6 shows what happens when the elevator cable in the sky-scraper breaks. This immediately closes a relay which electrifies the handy gravitation net below. Result—the elevator does not fall several floors, killing its occupants. Instead the elevator simply stays suspended as shown, until the repair crew "fishes" the elevator to the next floor where the passengers alight, none the worse for their experience.

After the repairs have been made, the power from the net is shut off because in an elevator *we desire the gravitation* in order to pull the elevator down. But going up is another matter. Instead of using a 10 horsepower motor to run the elevator as heretofore, we only need one of these little toy motors, because when the elevator goes up, the electrified net is switched on, and the car and its occupants then weigh nothing. Even 1/10 of a horsepower will be way sufficient to propel the elevator now.

Thousands of other uses will be found for the invention, and it will indeed revolutionize the entire globe. Life on this planet instead of being a daily drudge will become a pleasure. Perhaps then we will no longer need servants to do work about the house because it will be so easy to do it ourselves. Our tempers will be vastly improved, and as stated before our lives will be greatly prolonged.

The millennium certainly will have arrived for humanity when gravitation can be suspended at will by man.



SLIGHTLY USED STANDARD MAKE TIRES

Size	New Tube	Price	Size	New Tube	Price
30x3	$1.85	$ 4.50	35x4½	$3.00	$10.25
30x3½	2.00	5.00	36x4½	3.50	10.50
31x3½		5.50	35x5	3.75	11.00
32x3½	2.25	6.00	36x5		11.50
31x4	2.75	6.50	37x5	4.00	12.00
32x4	2.40	7.50			
34x4	2.70	8.50	**Special—Brand New**		
34x4½	2.85	10.00	32x3½, Cord		$12.25

Order now. Shipment made the same day. $1 deposit required with each tire order, balance C. O. D., subject to your examination. Specify whether you desire to have clincher or straight side tire.

Special cash discount of 5 per cent if full amount accompanies order.

CENTRAL TIRE & VULCANIZING CO.,
2309 S. STATE ST., Dept. E. E. CHICAGO

What 15 Cents Will bring You From the Nation's Capital

The little matter of **15 cts.** in stamps or coin will bring you the Pathfinder **13** weeks on trial. The Pathfinder is an illustrated weekly, published at the Nation's center, for the Nation; a paper that prints all the news of the world and tells the truth and only the truth; now in its **27th** year. This paper fills the bill without emptying the purse; it costs but **$1** a year. If you want to keep posted on what is going on in the world, at the least expense of time or money, this is your means. If you want a paper in your home which is sincere, reliable, entertaining, wholesome, the Pathfinder is yours. If you would appreciate a paper which puts everything clearly, briefly—here it is. Send **15c** to show that you might like such a paper, and we will send the Pathfinder on probation 13 weeks. The 15c does not repay us, but we are glad to invest in new friends.

Washington has become the World's Capital and reading the Pathfinder is like sitting in the inner council with those who mold the world's destiny.

THE PATHFINDER, Box 576, Washington, D. C.

Shoot Without Noise

Get more sport and fun out of shooting than you ever imagined was in it—and improve your accuracy, too. It's simple: a .22 calibre

MAXIM SILENCER

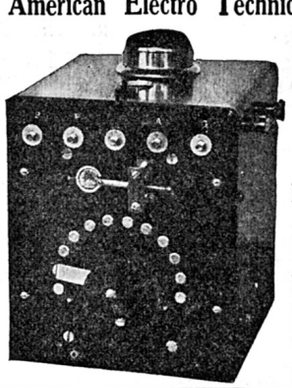
On Your Gun Does the Trick
IT SWALLOWS THE REPORT NOISE

Price $6.00. You can attach it yourself. Send 6c for book of unique shooting experiences with Maxim Silencer.

MAXIM SILENCER CO.,
89 Homestead Ave.,
Hartford, Conn.

American Electro Technical Appliance Co.

235 FULTON ST.
NEW YORK CITY



SPECIAL ARLINGTON TUNER

As Illustration **$14.00**

Arlington coupler parts complete to assemble, $4. Larger size, $5. Navy couplers, $14 and $15. Audion panel without cabinet, $10.50.

Switches, knobs, levers, rods, bakelite, cut to order; wire, all kinds, any length; cabinets, all parts to make your own apparatus.

Build Your Own PHONOGRAPH

IT'S EASY WITH OUR HELP

A few hours interesting work saves many dollars and gives you a machine exactly to suit your ideals. We furnish motors, tone arms, case material, blue prints and full instructions. Plays any record. You can make fine profit building phonographs for your friends.

Write Today for Our Free Blue Print Offer

Agents wanted for our ready built phonographs

Choraleon Phonograph Co.
207 Choraleon Bldg., Elkhart, Ind.

SAVE OVER HALF

DRIVER AGENTS WANTED

116-inch Wheel Base

158-inch Spring Suspension

5-Pass. Touring

To drive and demonstrate 1920, 4-cyl., 37 H. P. BUSH Car—Timken Bearings—Willard Batteries—2-Unit Stg. & Ltg.—Full Floating Axel. Write at once for the best Automobile Offer in existence—don't wait—prompt shipments. Money-back guarantee.

BUSH Address J. H. Bush, President, Dept. B15 MOTOR CO., Bush Temple, Chicago, Illinois

Boys, you can have Movies at your own home with this latest model

MOVING PICTURE MACHINE

Uses Standard Films same as the larger machines. Very easily managed. Simply turn the handle. Good Variety of Films always obtainable

PRICE Complete ONLY **$3.00** Postage 15c. extra Including Film.

Extra Films, 15c each postpaid

THIS IS A GENUINE MOVING PICTURE MACHINE and the motion pictures are clear, sharp and distinct. The Moving Picture Machine is finely constructed, and carefully put together by skilled workmen. It is made of Russian Metal, has a beautiful finish, and is operated by a finely constructed mechanism. The projecting lenses are carefully ground and adjusted, triple polished, standard double extra reflector, throwing a ray of light many feet, and enlarging the picture on the screen up to three or four feet in area. The light is produced by a safety carbide generator, such as is used on the largest automobiles. This throws a dazzling white light on the screen.

It is a solidly constructed and durable Moving Picture Machine. The mechanism is exceedingly simple and is readily operated by the most inexperienced. The pictures shown by this marvelous Moving Picture Machine are not the common, crude and lifeless Magic Lantern variety, but are life-like photographic reproductions of actual scenes, places, and people which never tire its audiences. This Moving Picture Machine has caused a rousing enthusiasm wherever it was used.

"The Baby" Double Action Hammerless Revolver

A HANDSOME AND MOST EFFECTIVE WEAPON

$6.50

Measures but 4¼ inches long

Takes regular .22 calibre cartridges

The new **Baby Double Action Hammerless Revolver** has been produced to meet the ever increasing demand for a revolver that would combine small size and light weight with the essential features of **Efficiency and Practicability**. It is small in size, yet is just as effective and serviceable as the most expensive weapon you can buy. Every lady should have a revolver and should know how to use it, and there is no safer or better one made than this. A great feature is its safety action that guards against accidental discharge, making it quite safe for young men and ladies. The illustration gives an idea of its appearance, but it must be seen and used to be thoroughly appreciated. The ammunition used is the standard .22-calibre (short) cartridge obtainable anywhere, or you may obtain the cartridges from us (cartridges can be shipped only by express). The revolver fires six shots in one loading. The operation of the charging mechanism is extremely rapid and absolutely reliable; six well aimed shots can be fired in as many seconds. The revolver is very well constructed, with finest nickel plated fluted barrel of cylinder, and it weighs only 4½ ounces. **The Price of the Baby Revolver is only $6.50, sent by mail postpaid to any address.**

THE EXPO WATCH CAMERA

The most wonderful and ingenious Camera made

It is but little larger than a watch, which it closely resembles. You can carry the **Expo** about in your pocket and take pictures without any one being the wiser.

One Cent a Picture

The Expo loads in daylight with 25 Exposure Films, costing 25c, thus the picture taking part of a whole day's outing may be had for the nominal sum of 25c—One cent a picture. 10 Exposure Films also obtainable. It is simplicity itself to operate. Takes pictures through the stem, where the **Rapid Fire Lens** is located. The photos (5/8 x 7/8) may be enlarged to any size.

Price $3.00

QUICK AS A FLASH Time and instantaneous shutters; weighs but 3 ounces; nickel plated. Endorsed by amateurs and professionals the world over. Thoroughly practical—printing and developing of films just the same as ordinary cameras—in daily use by the police, newspaper reporters, detectives, and the general public. Important beats have been secured with the Watch Camera by enterprising reporters. Produces clear, sharp negatives indoors or outdoors equal to any camera on the market, size or price notwithstanding.

Expo Watch Camera Postage 10c Anywhere

FILMS, 10 Exposures 15c, 25 Exposures, 25c. Leather Pocket Carrying Case, 35c

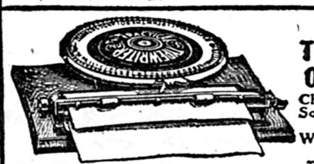
The CONJURER'S CASKET

Apparatus and Directions for a Number of Mysterious Tricks Enough for an Entire Evening's Entertainment 50c

ANYONE CAN DO THEM

It is great fun mystifying your friends. Get this Conjurer's Cabinet, and you will be the cleverest fellow in your district. It contains the apparatus for seven first-rate tricks, including The Disappearing Rose, that, when placed on the lapel of your coat, vanishes from sight at will; the Magic Vase and Ball Trick (a Wooden Ball is placed inside, and upon replacing the lid has disappeared and is found in someone else's pocket); The Magic Nail with which you can apparently cut your finger almost in two; the Wonderful Card Trick (a card is placed in an envelope, and when opened an entirely different card altogether is found); The Disappearing Coin Box (a coin is placed in the little wooden barrel, and when opened again, is found to have vanished entirely, or can be made to change into a coin of another denomination); The Famous Mesmerized Penny that defies the law of gravitation (suspends from the palm of the hand, nose, cheek, wall, clothing, etc.); The Glass Goblet and Vanishing Coin Trick (a coin is dropped into a glass of water, and when the water is poured out the coin has vanished). With the seven tricks described above we send full printed instructions for performing each trick, so that anyone can readily perform all the tricks to the great amusement of their friends or the public. Any boy of ordinary intelligence with this Cabinet of Tricks in his possession, can give a parlor entertainment not inferior to some regular magicians. Besides the tricks contained in the Cabinet, there are twenty-five other feats and illusions fully explained with full printed instructions, for which you can easily make or procure the necessary apparatus. Among them are The Mouse in a Pack of Cards, The Drawn Card, The Hat Trick, To Knock a Tumbler Through a Table, One Cent Rubbed into Two, To Find the Number Thought of, Mysterious Wedding Ring etc. We also send the secret of performing three wonderful stage tricks, as follows: The Act of Cremating a Woman, Walking on the Ceiling of a Room, and the Disappearing Lady, together with an article on legerdemain and valuable hints to amateur conjurers. **PRICE COMPLETE ONLY 50 CENTS.**

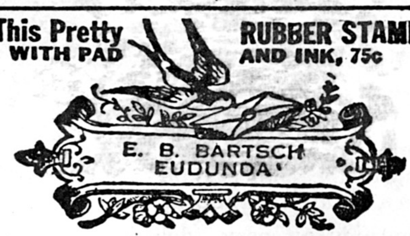
SIMPLEX TYPEWRITER ONLY $2.50



Cheap But Good. So Simple a Child Can Use It. We Guarantee the Writing.

Though so marvelously cheap, this machine is a thoroughly practical Typewriter. We positively guarantee it to produce writing equal in every respect to that of any $1.00 machine. It does not seem possible at the price, but let us send you a specimen of its work and you will be convinced. With reasonable care it will last a lifetime. It is so simple that a child just able to read can write with it. You can learn all there is to know about it in five minutes, and an hour's practice will make you an expert operator. Every business man must have a typewriter. Illegible pen writing is unbusinesslike and creates the impression that the firm is a no-account and slow-going concern. We assure you that the Practical Typewriter fully deserves its name as it is fit to do the correspondence of any business or profession, and to do it well. You should not miss this chance of securing a bargain. The letters of the alphabet, the numerals 1 to 10, and punctuation marks are so grouped that the letters most used are before the operator most of the time, enabling him to write rapidly. The rollers hold the paper in position while writing and at the end of each line a slight turn of the roller moves the rachet which makes a click and forces the paper forward, giving the proper line spacing, so that the lines are all an equal distance from each other, so desirable in letter writing. Each typewriter packed in a strong box, with full printed instructions for use. Price complete, $2.50 sent by mail postpaid.

This Pretty RUBBER STAMP WITH PAD AND INK, 75c



Here is the Prettiest rubber stamp you ever saw. At very great cost we have had this design specially engraved for our customers, and it cannot be obtained except through us. The design is ornamental, with floral decorations, with a beautiful dove in the upper part conveying its message of love, the desired name or name and address being tastefully displayed in the center. With this rubber stamp you can brand your letter paper, envelopes, postals and other stationery, and the elaborate and unique design will be admired by all. Placed upon the outside of envelopes, packages and other mail matter, it ensures their return to the sender in the event of non-delivery for any reason. It looks very pretty stamped on books, music, photographs, etc. With each stamp we include a self-inking stamp pad and a bottle of ink for re-inking the pad, and the PRICE of the COMPLETE OUTFIT, in box, is **ONLY 75 CENTS, POSTPAID.**

LOADED CIGARETTES

Just Like Ordinary Cigarettes, But Such Real Startlers!

A box containing ten apparently genuine Cigarettes. They contain a cap which explodes when about one-third is smoked.

They appear so real, and afford so good a smoke (while they last) that the victim is taken entirely by surprise. A great laugh producer and entirely harmless. **Price, box of ten 25 cents, postpaid.**

THE "LITTLE GIANT" TYPEWRITER

A First Class Writing Machine For $1.25

A perfect little typewriter for $1.25. There are thousands of persons who would like to use a typewriter but whose needs and business do not warrant the expense attached to the purchase and use of a fifty or seventy-five dollar machine. To such persons we confidently recommend our Little Giant. It is strongly made, but simple in construction, so that any one can quickly learn to operate it, and write as rapidly as they would with pen and ink. The letters of the alphabet most frequently used being so grouped as to enable one to write rapidly, the numerals, 1 to 10, and the punctuation marks being together. With this machine you can send your best girl typewritten love letters, address envelopes, make out bills, and do almost any kind of work not requiring a large expensive machine. With each typewriter we send a tube of ink and full printed instructions for using the machine. Price complete **$1.25** by mail postpaid.

THE "ATLAS" CALENDAR WATCH

PRICE $8.50

Shows the Date, Month, Day of the Week and Phases of the Moon

Keeps Time With Unerring Accuracy
Requires No Attention when once Set

Three Years' Guarantee

Only $8.50, Post Free

This remarkable Watch is a standing marvel to all who can appreciate the amount of detail involved in the production of such a complicated piece of Watchwork. As a timekeeper the "Atlas" will be found to be exact and reliable, and to all business men the advantage of an automatic calendar will appeal with great force. It is the watch to suit Travelers, Ranch Managers, Cowboys, Farm Hands, or anyone in an isolated district, whose daily routine has but little variety, and is frequently at a loss for day of week and date. As an ordinary timekeeper it is a watch of highest quality, and the calendar mechanism having been improved, simplified and fixed just beneath the dial, it is not likely to get out of order with ordinary use. The watch is self-acting, with the exception of the name of the month, at the top of the dial, which requires alteration only once a month. The rest is automatic, being worked by the mechanism of the Watch. The phases of the Moon are shown in the lower circle. A glance at the dial informs you not only of the exact phase, but enables you to quickly calculate when the new or full moon is due. The changes are made every 24 hours at midnight. The watch in illustration is telling at once that it is Wednesday, May 4, full moon, time, nearly twenty minutes to eleven. The movement is of the finest finish throughout, and is jeweled in 8 holes. Made in either gunmetal or nickel. **PRICE, ONLY $8.50 Post Free.**

SQUIRT RING

You may have a lot of fun with this Sparkling Gem Squirt Ring. It consists of a handsomely plated ring, attached to a rubber ball, so arranged that the latter is quite out of view when the ring is in the proper position. Such an attractive looking ring as this cannot fail to be the center of attraction. While the victim is absorbed in getting a closer view, you just squeeze the rubber ball and the observer experiences a very great surprise. **PRICE 20 CENTS**, three for 50 cents, postpaid. J. S. & CO

MULTIPLYING BILLIARD BALLS.

The Best Feat of its Kind

This trick is as effective as it is surprising. The performer hands around the ball for examination, and immediately it is returned to him he seizes it by the tips of his thumbs and fingers and a second ball mysteriously appears. These are held in full view of the audience by the tips of the fingers of the left hand, and even while being placed in position, another ball unexpectedly makes its appearance. Finally the magician apparently suffers from some kind of spasm and yet another ball is the result. The feat can then be reversed, the balls disappearing one after another until none remains. It is a very interesting trick that is quite easily performed by following the directions that accompany the apparatus. **PRICE, 25 CENTS.**

BOOKS

That You Should Have.

Cloth Bound

A Practical Course in Mechanical Drawing..	$ .65
Practical House Framing....................	.65
Hints for Carpenters.......................	.65
Architectural Perspective..................	.65
Practical Concrete-Block Making............	.65
Modern Cement Sidewalk Construction........	.65
How to Measure Up Woodwork.................	.65
Easy Lessons in Architecture...............	.65
Hints for Painters and Paper-Hangers.......	.65
Hand-Forging and Wrought Iron Ornamental Work	1.25
Pattern-Making	1.25
Dustman's Book of Plans and Building Construction	2.50
How to Make a Wireless Set.................	.50
Metal Work and Etching.....................	.50
Electroplating	.50
Wood-working for Amateur Craftsmen.........	.50
Gleason's Veterinary Hand Book.............	1.50
Famous Pictures—The Book You Should Buy.	3.50
Complete Manual on Hypnotism...............	.90
Motor Truck and Automobile Motors and Mechanism	1.50

AN UNDOUBTED BARGAIN

COMPLETE SHAVING OUTFIT

First Class Razor, Strop, Shaving Brush, Hone and Cake of Soap

Only $1.85 the lot; we pay postage

This complete Shaving Outfit will commend itself to all shavers. We offer you a first class 1⅛ inch hollow ground guaranteed Razor, 1 cake Williams' Shaving Soap, 1 good quality Leather Razor Strop, 1 good Shaving Brush, and 1 Champion Razor Hone—five first class articles, complete for ONLY $1.85, postpaid to any address. The Razor is made of fine quality steel, polished black or white handle, fully magnetized, that will give you excellent service, and many years of pleasant and comfortable shaving. You may try it for a week, and if you are not in every respect satisfied with your purchase, return the outfit to us and we will refund your money in full.

BOOKS

That Everyone Should Read.

Cloth Bound

Dyke's Motor Manual.....	$2.50
Automobile Troubles and How to Remedy Them...	1.50
Automobile Ignition, Timing and Valve Setting, Self-Starting and Lighting, including Ford System	1.50
Automobile Driving, Self-Taught	1.50
Motion Picture Making and Exhibiting	1.50
The Practical Handbook of Gas, Oil and Steam Engines	$1.50
Electricity and Magnetism.	1.25
Power Gas and the Gas Producer	1.25
A B C of the Motorcycle.	1.50
Gas Engine Troubles and Installation	1.50
Motor Boats, Construction and Operation; Hydroplanes, Hydro-aeroplanes.	1.50

Mandel-ette One Minute Camera

Entirely Self-Acting from Start to Finish

COMPLETES A PHOTOGRAPH IN A MINUTE

NO SKILL or KNOWLEDGE NEEDED

NO DARK ROOM NO FOCUSSING NO MESS NO TROUBLE

PRICE, Only $8.50 The Complete Outfit. Takes Pictures 3¼ x 2¼ in.

A child can take a good picture at the first try. A source of real joy for amateurs and their friends. Just think what a marvellous advance this is in the art of photography. You have simply to hold the Camera, aim at the subject, press the trigger, and the picture is taken. No apparatus ever devised can compare with it for convenience, cheapness and rapidity. There is no trouble, no delay, no focussing, no developing, no fixing, no printing, no toning, no dark room, no mess. In one minute you really deliver an excellent portrait, all complete. The camera does it all. You have but to let it work. It cannot go wrong. WE GUARANTEE IT FOR A YEAR. All that is required is the Camera and a few positive post-cards, and a little 3-in-one Developer. Nothing else. The pictures are finished right within the Camera itself and at the very spot where they were taken. No previous experience of photography is necessary. There are NO FAILURES. Photos can be taken at any distance, far or near. It measures 4½x6x4 inches, is no heavier than any other camera, and easily carried about from place to place. 15 or 50 Post Cards can be loaded in the Camera in broad daylight at one time; and can be taken in rapid succession. The Cards are always in the right position to be photographed. The developing chamber is a part of the Camera itself and is so arranged that the exposed Post Cards may be developed in rapid succession. A number may be developed at the one time. It is impossible to over-develop. After developing simply place the Post Cards in clear water and they are positively permanent. It is a rattling good money-maker. 25 cents a minute. At shows, race meetings, bazaars, fetes, picnics, excursions, in fact wherever a crowd gathers, the Camera is fairly rushed by people eager to have their portraits taken, for which they readily give 25c each, and often take three or four at a time. It is the fastest money-maker in existence, and it is being successfully operated by men, women, boys and girls who had no experience in photography. PRICE of CAMERA, complete with 15 Post Cards and sufficient material to develop them, ONLY $8.50.

SHARPEN-M-ALL SAFETY RAZOR STROPPER

SHARPENS EVERY KIND OF SAFETY RAZOR BLADE

Sharpens the Gillette and Durham Duplex both edges at one time

ALSO SHARPENS THE GEM JUNIOR, EVER READY, KEEN-KUTTER, MARR CROSS, CLARK, AUTOSTROP, STAR CRUSTEEL, AND ALL OTHERS

By using the SHARPEN-M-ALL STROPPER, you will not only get BETTER SHAVES, but you will SAVE MONEY on blades, as you will be able to get from 150 to 200 shaves from one blade, and the last shave will be as good as the first. The construction is simple and will last a lifetime. There are no parts that can possibly get out of order. Any novice can use it just as well as the most expert barber. It is operated by simply turning the lever or handle as shown in the illustration. It has two spiral rollers that travel from heel to point as they are revolved, giving the CORRECT DIAGONAL STROKE. There are no screws, adjustments, or any kind of tinkering necessary to operate the machine. The rollers are made of a special material that STROP AND HONE the blade at the same time. The rollers turn only one way, so there is no fear of damaging the blade or the stropper. The SHARPEN-M-ALL is packed in a handsome case, 4x2½x1⅛ in., with three holders and full instructions. The weight of the complete machine is but eight ounces. Price, only $1.50, postpaid.

Price, $1.50 postpaid.

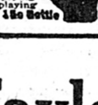
ANARCHIST BOMBS

Consists of a little glass vial, containing in liquid form a chemical which will produce a most horrible odor. One dropped in a room full of people will cause more consternation than a limburger cheese. The smell will entirely disappear in a short time. 3 Boxes for 25c, shipped by express only with a Dollar's worth of other merchandise.

ITCHING POWDER

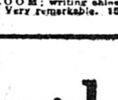
This is another good practical joke; the intense discomfiture of your victims to everyone but themselves is thoroughly enjoyable. All that is necessary to start the ball rolling is to deposit a little of the powder on a person's hand and the powder can be relied upon to do the rest. The result is a vigorous scratch, then some more scratch, and still some more. 3 Boxes for 25c. Sent only by express. (Must order at least One Dollar's worth of other merchandise.)

INVISIBLE INK



The most confidential messages can be written with this Ink, for the writing **MAKES NO MARK.** Cannot be seen unless you know the secret. Invaluable for many reasons. Keep your postals and other private memorandums away from prying eyes. Great fun for playing practical jokes. Only 15c Bottle

LOVE LETTER INK



Writing written with this remarkable ink vanishes entirely in a few weeks (sooner if desired), leaving the paper QUITE BLANK. 15c p. pd.

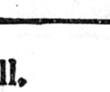
LUMINOUS INK Writing can be READ ONLY IN A DARK ROOM; writing shines like fire. Quite invisible at daytime. Very remarkable. 15c bottle; 3 for 40c postpaid.

NEW BOOK ON ROPE SPLICING

USEFUL KNOTS, HITCHES, SPLICES, ETC.

How Different Knots Are Made and What They Are Used For, Knots to Use and Knots to Avoid.

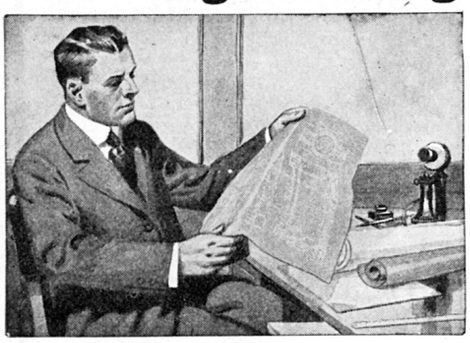
A most practical handbook giving complete and simple direction for making all the most useful knots, hitches, rigging, splices, etc. Over 100 illustrations. All about wire rope attachments, lashing, blocks, tackles, etc. 37 Heraldic Knots illustrated. Of great value to mechanics, riggers, campers, boatmen. Price 20c p. pd.



Taylor Barnard & Co.

24 E. Adams Street, Chicago, Ill.
Department 145

Mechanical Engineering



Learn at Home!

Employers everywhere are looking for men with mechanical ability. Splendid salaries and rapid advancement are offered.

There is an easy, delightful way in which you can learn right at home in spare time. For 28 years the International Correspondence Schools have been giving men and women just the training they need for success in mechanical engineering and more than 200 other subjects. Hundreds of thousands have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least and it will bring you information that will start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon *now*.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6221, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

☐ MECHANICAL DRAFTING	☐ SALESMANSHIP
☐ STRUCTURAL DRAFTING	☐ ADVERTISING
☐ SHIP DRAFTING	☐ Show Card Writer
☐ ELECTRICAL DRAFTING	☐ Sign Painter
☐ ARCHITECTURAL DRAFTING	☐ ILLUSTRATING
☐ SHEET METAL DRAFTING	☐ Cartooning
☐ BOILERMAKER DRAFTING	☐ BUSINESS MANAGEMENT
☐ BRIDGE DRAFTING	☐ Private Secretary
☐ MACHINE DESIGN	☐ BOOKKEEPER
☐ ELECTRICAL ENGINEER	☐ Stenographer and Typist
☐ Electric Lighting and Railways	☐ Cert. Public Accountant
☐ Electric Wiring	☐ TRAFFIC MANAGER
☐ Telegraph Engineer	☐ Railway Accountant
☐ Telephone Work	☐ GOOD ENGLISH
☐ MECHANICAL ENGINEER	☐ Teacher
☐ Machine Shop Practice	☐ Common School Subjects
☐ Gas Engine Operating	☐ Mathematics
☐ CIVIL ENGINEER	☐ CIVIL SERVICE
☐ Surveying and Mapping	☐ Railway Mail Clerk
☐ STATIONARY ENGINEER	☐ AUTOMOBILE OPERAT'G
☐ Marine Engineer	☐ Auto Repairing
☐ ARCHITECT	☐ PLUMBING AND HEATING
☐ Contractor and Builder	☐ Textile Overseer or Supt.
☐ Concrete Builder	☐ Navigation ☐ Spanish
☐ Structural Engineer	☐ AGRICULTURE ☐ French
☐ CHEMIST	☐ Poultry Raising ☐ Italian

Name_____

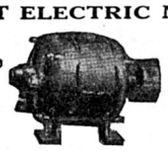
Present Occupation_____ 7-25-19

Street and No._____

City_____ State_____

REBUILT ELECTRIC MOTORS

General Electric
Westinghouse
Crocker-Wheeler
Emerson
Century
Wagner
etc.



All Motors Guaranteed For One Year

Motors bought, exchanged and repaired
ELECTRICAL SUPPLIES
Wholesale Prices
Sockets, wire, tape, loom, fuses, switches, cut outs, etc.
New illustrated catalogue free. Satisfaction guaranteed or money refunded.

HYRE ELECTRIC CO.
631 S. Dearborn St. Chicago, Ill.

STUDY HUMAN NATURE Learn to recognize the marks that nature has stamped all over the human form. Look through and beyond the deceptive smile. Know the strong and weak points of those you meet. Send 5 cents in stamps for "PERSONAL POWER," a little book that tells how. Address J. C. Koss, Secretary Progress League, 31 Union Sq., N. Y. City.

Science In Slang

By EMERSON EASTERLING.

(*Continued from page* 1037)

type for work. In a. c. we have both the brush and commutator, and induction types. The induction works on the principle of fields changing due to the fluctuations—speaking of that, it reminds me, the current in the direct current generators are not constant but fluctuate from zero to the peak; of course in the improved types the fields are arranged so as to keep a peak handy to fill up the gap at zero, I suppose they do; I can't see why they shouldn't. It seems to me they could arrange it so.

"As I was saying, the field fluctuating from zero to the peak, or maximum, and the pull being in reverse directions each wave—were it not for the windings rendering the pull in the same. But it goes like this: The field yanks the armature around in one direction. As that field dies out and the next field builds up the pull is gradually moved to the next pole. By winding the armature and shorting it in itself, according to the results of Mike's experiments in induced currents, the armature core would tend to be possest with a different polarity, which would attract it to the field poles."

The Giant Canadian Reflector

By PROF. FLOYD L. DARROW.

(*Continued from page* 1011)

It may be asked, "Of what value is all this?"—"Why spend $200,000 on the perfection of an instrument which adds nothing to material comfort?" But it may be answered that Astronomy is the oldest and noblest of the sciences. It has added more to our knowledge of the Universe than any other. It pilots our fleets over the uncharted wastes of the sea and guides the caravan across the trackless sands of the desert. By its aid we establish boundary lines and without it surveying would be impossible. "Correct time" is absolutely dependent upon astronomical observations. But more important than all else is the broadening of men's minds to comprehend a universe of vast extent. Coincident with the growth of astronomical science has been the conquest of superstition and the sway of intellectual progress. Every other science magnifies the achievements of this little planet, but Astronomy asks us to remember that this boundless universe doubtless teems with life, even as a drop of water from a stagnant pool. Only when we behold the infinite depths of space thru these marvelous instruments of science can we have even an approximate appreciation of the relatively insignificant part which our little earth plays in the universe of time and events.

It is a matter of no little pride to Americans that all the great telescopes of the world have been made in this country. The casting of the glass has been done abroad, but the work of grinding and construction are the products of American genius. Dr. John A. Brashear, of Pittsburgh, ground and polished the big Canadian mirror and The Warner & Swasey Company of Cleveland, constructed the observatory and did the mounting.

Until within the last fifteen years the biggest telescopes of the world have been of the *refracting* type. Now it seems probable that the practicable limit of big lenses has been nearly if not quite reached and the astronomical progress of the fu-

(*Continued on page* 1056)

999 PEOPLE

Out of every thousand can be benefited by

CHIROPRACTIC

Because this method of healing always benefits when used by a properly qualified practitioner.

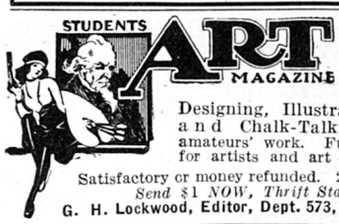
Therefore the demand for Chiropractors is limited only by the supply.

BE ONE OF THE SUCCESSFUL

By taking our residential course, the details of which will be sent you free upon request.

THE MAN WHO SUCCEEDS IS THE MAN WHO ACTS!

THE NEW YORK COLLEGE OF CHIROPRACTIC
1416 Broadway New York City



Publishes cash art assignments, lessons and articles on Cartooning, Designing, Illustrating, Lettering and Chalk-Talking. Criticises amateurs' work. Full of information for artists and art students.

Satisfactory or money refunded. 20c a copy, $1 for 6
Send $1 NOW, Thrift Stamps Taken
G. H. Lockwood, Editor, Dept. 573, Kalamazoo, Mich.

AVIATION Information FREE

Send us your name and address for full information regarding the Aviation and Airplane business. Find out about the many great opportunities now open and how we prepare you at home, during spare time, to qualify. Our new book "Opportunities in the Airplane Industry" also sent free if you answer at once.

AMERICAN SCHOOL OF AVIATION
Dept. 7492 431 S. Dearborn St. CHICAGO

DIAMONDS ON CREDIT

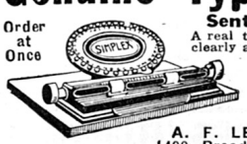
Write for Free Catalog. Over 2,000 illustrations of Diamonds, Watches, Jewelry. Select any article desired, have it sent to you prepaid. If satisfactory, send us one-fifth of the purchase price and keep it, balance in eight equal monthly amounts.

OFTIS BROS & CO. EST. 1858 **National Credit Jewelers** Dept. K-22 108 N. State St. CHICAGO, ILL. **Liberty Bonds** Accepted Stores in Leading Cities

Send for a Complete Catalog of
MASONIC BOOKS
Jewelry and Goods
REDDING & CO.
Publishers and Manufacturers
Dept. 5 200 Fifth Avenue, N. Y.

Genuine Typewriter $2
Sent Postpaid Only

Order at Once



A real typewriter that writes letters as clearly and intelligently as one that costs $50.00. Write business and social letters. Do school work. Learn to typewrite. A remarkable machine, fully guaranteed, for only $2. Every man, woman, boy and girl should have one.

A. F. LEWIS TYPEWRITER CO.
1400 Broadway New York

HEAD ACHES FLU AK NEU-RAL-GIA WOMEN'S ACHES
ASK FOR A-K TABLETS

STAMMER

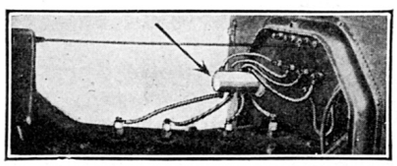
If you stammer attend no stammering school till you get my big new FREE book and special rate. Largest and most successful school in the world curing all forms of defective speech by advanced natural method. Write today. **North-Western School for Stammerers, Inc., 2331 Grand Ave., Milwaukee, Wis.**

ARE YOU BASHFUL, TIMID

Self Conscious, Embarrassed in Company. Let us tell you how you can overcome these troubles and acquire Poise, confidence, assurance and a magnetic personality. Address **The Veritas Science Institute, 1400 Broadway, New York, Desk 15.**

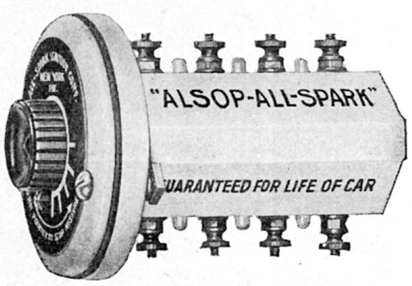
THE "ALSOP—ALL-SPARK" WILL PREVENT SPARK-PLUG TROUBLES

So why risk having your car stall on a cold, snowy night, when your starter may fail to work and you will have to get out and crank and crank? Why have your motor skip and miss? Why worry about cold weather motor troubles, poor spark plugs, low grade gasoline? All the things that worry motorists in cold weather most, never will worry the man who has this wonderful little device installed in his car.



The All-spark installed in a Ford

It can easily be installed in any 4-cylinder car.



THE "ALSOP---ALL-SPARK"

Insures a hot, fat spark. It makes old carbon-choked plugs fire. It insures increase of gasoline mileage.

It develops greater power. This convenient, handsome little device for any four-cylinder motor will be sent to you with our money-back guarantee for **$7.50**

It is safe, convenient and positive in action. There are no dangerous, exposed spark gaps which may set your car afire or make your engine hard to start.

WE WANT LIVE DEALERS—LIVE DEALERS WANT THE ALL-SPARK

ALL-SPARK IGNITION CO., INC. 13-X WATER STREET NEW YORK CITY

LICENSED BY DE FOREST
AUDIOTRON
The Original Tubular Vacuum Amplifier

The AudioTron Vacuum Tube is now manufactured and sold as a genuine audion licensed under DeForest Patents Nos. 841387 and 879532 to be used only for amplification in radio communication and only for experimental and amateur purposes and only in audio frequency circuits.

The AudioTron has a double filament of special thorium tungsten and the operating life is over 2,000 hours. No special socket is required. The electrical and mechanical dimensions result in a heavy plate current and corresponding signal strength. Plate voltage under 40. Our guarantee insures satisfaction.

PRICE $6.00 EACH

If your local dealer cannot supply you we will ship postpaid when cash accompanies order.

The AudioTron Exclusive Guaranty: Each and every AudioTron is guaranteed to arrive in good condition and to prove fully satisfactory. Replacement of unsatisfactory tubes will be made free of charge.

AudioTron Audio-Frequency Transformer $7.00

Laminated closed core, two coil type.

DEALERS:—Write for our attractive trade Proposition.

AUDIOTRON SALES CO. Lick Bldg. SAN FRANCISCO, CALIF.

Become a Doctor of Naturopathy

Learn at Home Or In Our Classrooms

EARN $3,000 to $5,000 A YEAR

NATUROPATHY is the only method of drugless healing which will qualify you at the same time as Osteopath, Chiropractor, Hydropath, Dietitian, Electropath, Mechanotherapist, Neuropath, Zonetherapist, Mental Scientist, etc.

NATUROPATHY includes *all* Drugless Methods of Healing: Water Cure (Hydrotherapy), Massage, Swedish Movements, Chiropractic, Mechano-Therapy, Electropathy, Osteopathy, Kneipp, Lust, Purinton, Kuhne, Bilz and Ehret Systems, Phytotherapy, Phototherapy, Heliotherapy, Sun, Light, Air, Diet, Fasting, Earthpower, Milk, Work and Rest Cures, Psychotherapy, Mental Science and Life Conservation.

Residence School

At our residence school every student receives practical demonstrations, attends practical lectures and does practical work under competent instructors. He learns everything about this marvelous method of healing and fits himself to start practice in a profession that is paying former graduates from $3,000 to $5,000 a year and many even more.

Courses for laymen, doctors and graduates of all schools of healing.

Regular courses of 1, 2, 3, and 4 years of 9 months each, beginning at any time. Preparatory Home Course for beginners by studying the Naturopathic Library.

Home Study Course

With our Home Study Extension Course the student learns everything taught at the school. The only difference being that he can remain at home to study, studying in his spare time and earning the cost of the course as he goes along. But the lessons are the same and the training just as thorough.

Post-Graduate Residence Course beginning the first of every month. Special Residence Beginners and Post-Graduate Courses are also given at the Florida Winter Branch of the Naturopathic College at Tangerine, Fla., and at the Summer Branch at Health Resort and Nature Cure Sanitarium, "Yungborn," Butler, N. J.

Degree Doctor of Naturopathy or Doctor of any single Branch of Drugless Therapeutics awarded those who graduate successfully. Send 25c for descriptive literature, Prospectus, and Application Blank.

AMERICAN SCHOOL OF NATUROPATHY
The Only Drugless University
B. LUST, N.D., D.O., M.D., Founder and President. Incorporated in Three States. Founded 1896
110 East 41st Street New York, N. Y.

Electrical Engineering

offers you exceptional opportunities for assuming a position of executive and financial importance in this great uncrowded field of enterprise.

A Bachelor of Science degree in Electrical Engineering may be obtained here in 3 years. With 14 High School Credits, or as a graduate of our Institute of Electrotechnics, you can enter the College of Electrical Engineering.

A Large Faculty of Prominent Educators

will direct your training in the greatly enlarged and extended laboratories, class rooms and drafting rooms of this school. Join the ambitious young men now preparing for success in the electrical field.

Winter Term Now Open

College of Electrical Engineering,
158-373 Broadway, Milwaukee, Wis.
Gentlemen:—Please send, without obligation on my part, complete information and illustrated bulletin concerning your 3 year course in Electrical Engineering.

Name .....
Address .....
Age .....Education .....

You may "Earn While you Learn" if you like. Opportunity to make up deficient high school credits.

Send in the Coupon NOW for latest bulletins and full particulars FREE.

SCHOOL OF ENGINEERING OF MILWAUKEE
"College of Electrical Engineering"
158-373 Broadway Milwaukee, Wis.

The Breakers

Atlantic City's Newest Fire-Proof Hotel

Ocean Front. Unusually attractive during the Autumn and Winter seasons.

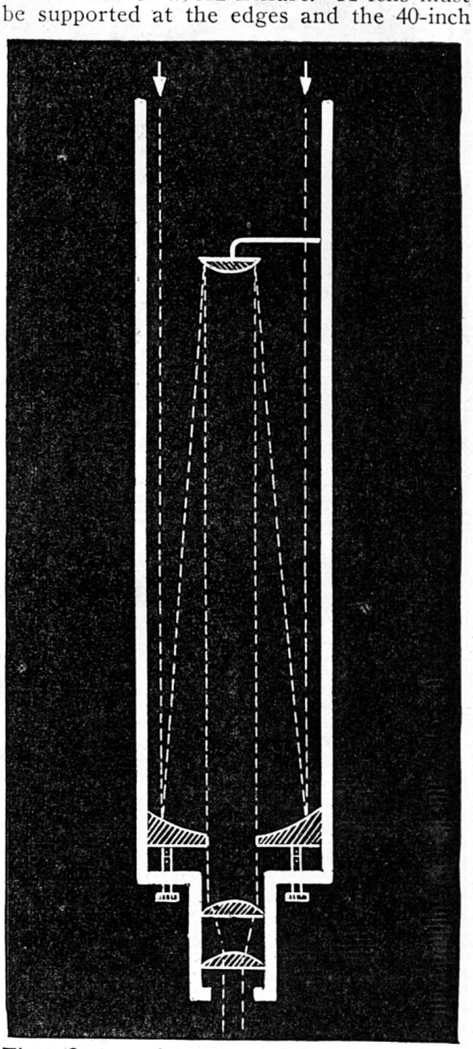
American and European Plans

Luxurious lobbies, spacious verandas and sun parlors overlooking the ocean. Charming afternoon musicales and evening concerts. A palatial residence for those seeking rest and recreation. Sea water baths. Fireproof garage. Illustrated booklet sent on request.

The Giant Canadian Reflector

(*Continued from page* 1054)

ture must be made with the *reflecting* instrument. Certainly the reflector possesses several points of decided superiority. It is claimed that its cost is much less than that of a refractor of the same size. Smaller and less expensive housing for it is possible. While it is true that for visual observation better definition is secured with the *refractor,* yet for photographic work, which is now of chief importance, the *reflector* is unquestionably superior. It brings all rays of light of all colors to the same focus without dispersion. Another point to consider is the mounting of the optical unit. Both lenses and mirrors must be so mounted as to avoid flexure. A lens must be supported at the edges and the 40-inch



The Cassegrain Telescope Scheme. The Image Reflected from the Main Mirror Is Thrown Up Again Onto a Second Smaller Mirror, Thence Downward Thru a Hole in the Large Mirror, to the Eyepiece Below.

Yerkes lens is thought to be about the limit of size for successful mounting in this way. The mounting of a large mirror is not so difficult. It may be very thick and so supported at the back as to avoid distortion. But the thicker the lens the more light there is lost by absorption. The Yerkes and Lick lenses now transmit only 50 per cent of the light that falls upon them and doubling their size would permit only 25 per cent to pass. A mirror reflects 60 *per cent* of the light *and the thickness of the glass has no effect.* Reflectors are better for spectrographic work, too. Therefore, it would seem that the great telescopes of the future will be reflectors, like those of Canada and Mount Wilson.

(*The next paper will appear in an early issue.*)

Trolleys We Have Met

(*Continued from page* 1007)

pose of retaining, for one thing, the franchise right-of-way, or "track rights," of the trolley company, as this franchise stipulated that at least one car must be operated over the system every 24 hours.

THE CONDUIT OR SLOT TROLLEY.

At Figs. 5 and 6 are shown a single and double pole *slot trolley* such as used in several large cities, including New York and Washington, D. C. These do away with any trolley poles or exposed third rails, but they have always, or at least until recent years, presented more or less trouble, especially in stormy weather, owing to the large amount of water, due to rain and snow, which gets into the conduit in which the live third rails are mounted, which often causes short circuits, etc.

At Fig. 5 a single-pole slot system is shown. Here the current passes, let us say, from the insulated third rail slot, up thru a special, very thin insulated contact shoe passing down into the slot and riding along within the slot as the trolley proceeds. This current is then led thru the usual controller and motor elements. The current is here returned thru the grounded shaft and wheels of the car to the rails on which it runs, and thence back to the power house.

The double-pole conduit is shown at Fig. 6; here no current is returned thru the running rails, but both positive and negative conductors are mounted within the conduit. Of course, in this case, a special double-contact insulated shoe has to be used to pick up the current from the two rails. The path of the current thru the usual controller and motor elements is shown by dotted lines.

THE GASOLINE-ELECTRIC CAR.

This is one of the latest advances in electric interurban car design and is capable of very high speed and long runs. These cars embody a complete, self-contained electric generating plant and don't use any third rails, slots or trolley poles. A gasoline engine on board the car drives a dynamo of suitable size; this dynamo supplying electric current thru a speed controller to the motors on the trucks of the car.

Current is also available from the same source for heating and lighting purposes. This car can make a run of 75 or 100 miles very easily and the only fuel required is gasoline. Several of these cars are being operated in the central west and in the western part of the United States.

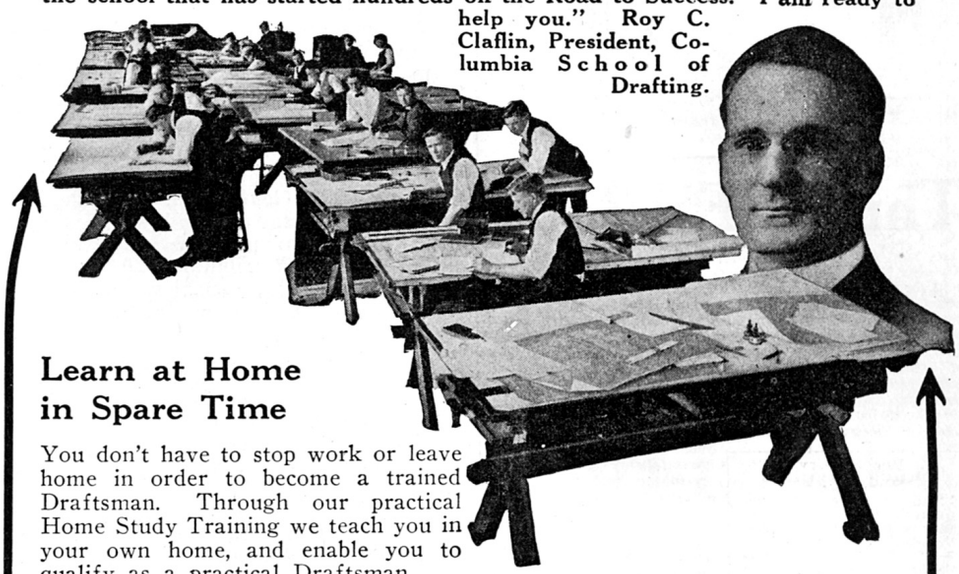
WASHINGTON, D. C., TROLLEYS FITTED FOR WIRE AND SLOT SERVICE.

Where the slot system is used it is the general thing that these cars do not travel beyond the districts equipt with that particular system, but in Washington, D. C., many of the cars run out thru suburban districts, and it is interesting to see the change made from the elevated trolley wire and pole system, to the slot arrangement. The operation requires but a few moments. What happens is this: The conductor pulls down the trolley pole at the rear of the car, and slips it under the hook on the roof. At the same time, if you are observant, you will have noticed the motorman equally busy at the front end of the car spinning a large wheel mounted on a substantial iron pedestal, beside the usual motorman's controller. When he turns this wheel a set of gears and connecting rods are put in motion underneath the car, which lowers the shoe down into the slot, and the car is then ready to proceed thru the city streets, deriving its current thru the underground slot distribution system.

Learn Mechanical Drafting

Earn $35 to $100 a Week

"Get into the profession of big pay and Rapid Advancement with the help of the school that has started hundreds on the Road to Success. I am ready to help you." Roy C. Claflin, President, Columbia School of Drafting.



Learn at Home in Spare Time

You don't have to stop work or leave home in order to become a trained Draftsman. Through our practical Home Study Training we teach you in your own home, and enable you to qualify as a practical Draftsman.

No Previous Training Required

Owing to the comprehensive nature of our course, you need no previous training in the subject. Though you have never done any kind of drawing before, you can become a thorough Draftsman by following our instructions.

Can Learn in Short Time by Our Methods

The reason for this is that we eliminate unnecessary theoretical work and concentrate upon the PRACTICAL problems such as confront the professional Draftsman. We do not require you to spend months of your time on "preliminary" work, but start you on REAL DRAFTING at once. That is one reason why our students "make good" so readily.

Our Graduates Get to the Top

The universal success of our graduates as Professional Draftsmen, many of whom have advanced rapidly to positions of Chief Draftsmen, is evidence of the REAL VALUE of the training given by the COLUMBIA SCHOOL OF DRAFTING. Large numbers of our students have secured excellent positions even before completing their courses. We gladly cooperate with our students and graduates in securing desirable positions, which has been easy for us owing to the many demands upon us to supply our "product" for these positions.

Draftsmen Get $35 to $100 a Week

Our graduates have shown their ability to reach high salaries RAPIDLY, owing to their practical training. They secure excellent salaries AT THE START, as high as $2,000 a year. The usual pay of Draftsmen is $35 to $100 a week.

The Demand is Greater Than the Supply

The demand for properly trained Draftsmen has always been greater than the supply, but this is more so today than ever before, owing to greatly increased construction and mechanical development. The Draftsman is an essential connecting link in all engineering work. This great demand is indicated by the long lists of want ads for Draftsmen in the daily papers, especially those of industrial centers.

Specialists in Mechanical Drafting

The COLUMBIA SCHOOL OF DRAFTING not only trains Draftsmen by mail but also maintains a large local institution of the highest standing. For many years it has been the leader in SPECIALIZING on the teaching of DRAFTING. This is an obvious advantage over teaching Drafting only as a side issue.

Drawing Outfit Furnished

We supply all our students with a drafting outfit for use throughout the course. There is no extra charge for this, and it becomes your personal property when the course has been paid for in full.

Book of Particulars Sent FREE

If you are interested in becoming a practical Draftsman through the thorough training of the COLUMBIA SCHOOL OF DRAFTING, whereby you can enter a Profession in which your services will always be in demand, you are invited to write us for our free book of particulars, which describes our school and methods. For your convenience you can fill out and

Mail This Coupon To-day

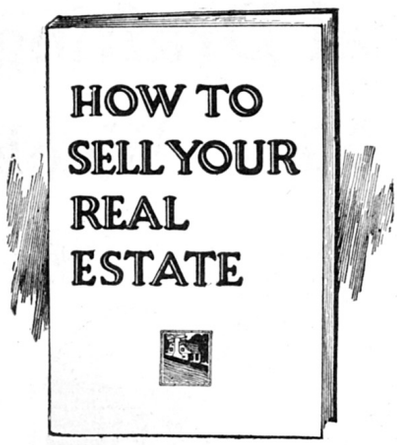
COLUMBIA SCHOOL OF DRAFTING,
14th & T Sts., N.W., Dept. 1081,
Washington, D. C.

Without obligation to me, please send me full particulars of your practical home study training in Drafting.

Name .....

Address .....

City..... State.....



This FREE Book

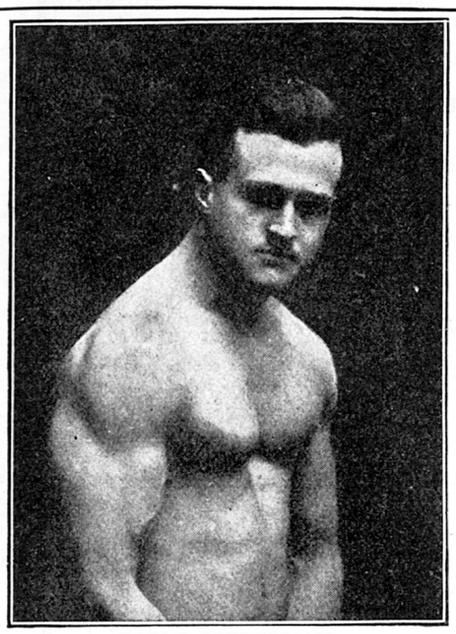
tells how you can get cash for your property by using the *Simplex Plans for Selling Real Estate*, which have already sold more than 5,000 properties of all kinds in the U. S. and Canada. No matter where your property is located, these successful plans will show you how to sell it *yourself*, without employing agents, or paying commissions to any one. Don't spend a *minute's* time, an *ounce* of effort or a *cent* of money *trying* to sell without first reading this important book, and learning *how* to sell your property *quickly, economically* and at the *highest possible price*. The reading of this book has *saved property owners hundreds and thousands of dollars in commissions* and it can do the same for you. As the book is sent *absolutely free*, you have *everything to gain* and *nothing to lose*.

Send your name and address at once—a postal will do—and you will receive by return mail, postpaid, a copy of this important book, *without cost or obligation*.

Quick Results!

"Sold my house within two weeks by following the Simplex Plans."—*F. Stark, Wis.* "Sold for cash in 10 days."—*W. H. Cartland, Mass* "Sold my property. Your plan quickest I ever saw."—*Johnson String, N. J.* "Sold my home for cash within three weeks."—*M. E. Lounsberry, Okla.* "Sold my lots for cash."—*R. P. Moodie. Ottawa, Can.* "Sold for cash within a few weeks."—*M. P. Jones, Iowa.*

THE SIMPLEX CO.
Dept. 170
1123 Broadway
New York



EARLE LIEDERMAN
The Acme of Physical Perfection

BE A MAN OF STRENGTH AND POWER

What I have already done for thousands of others I can do for you. I will broaden your shoulders, deepen your chest, (increasing your lung power) enlarge your arms and strengthen every muscle of your body. I will fill you with vim and pep so that you will be admired for your perfect physique and dominance of strength.

Send for MY NEW BOOK
"Muscular Development"

It tells the secret. Handsomely illustrated with 25 full page photographs of myself and some of the world's best athletes whom I have trained. This valuable book and my special offer will be sent on receipt of 10c, stamps or coin, to cover cost of wrapping and mailing. Don't delay! Send for it now, while it is on your mind.

EARLE E. LIEDERMAN
Dept. 217 203 Broadway, New York

Electrifying The Holy Land

(*Continued from page* 983)

evaporation, namely, up to about forty-eight hundred square miles, an increase corresponding to one-fifth of the recent area. With an efficient head of not more than 656 feet, the plant would produce more than forty thousand horsepower.

This power would be utilized in the following ways:

For the production of lime nitrat from the air and for local mining operations.

For the distribution of electric light and power throughout the country.

For a pumping plant at the southern end of the Lake of Genezareth, which should be regulated by dams and by lowering the surface level, also possibly by making the River Jarmuk a tributary. At a suitable altitude above the normal water level, two canals would be built running from the lake parallel with the River Jordan, and from these canals the irrigation water would be distributed to the local irrigation centers among the freshly cultivated fields, sloping for drainage toward the Jordan. By economizing the water during the dry season, and by a thoro regulation even above the Lake of Genezareth, there would thus be obtained an ample supply of water for the irrigation of several hundred thousand acres, and perhaps some water might even be spared for a third canal parallel to the Jordan and the coast line, and irrigating the Plain of Sharon, with drainage toward the sea. Thousands of existing cisterns, and also some quite imposing waterworks dating as far back as the reign of David, could be partially included in these works.

For large salt works to produce common salt from sea water. From the point where the turbine pipes join the tunnel, a horizontal canal could be constructed from which a thin film of brine would be allowed to escape down the steep, sun-baked rocks, toward the Dead Sea. The water would evaporate, and the salt could be collected in the ordinary way.

For the exploitation of the vast deposits of asphalt in the Plains of Sodom and Gomorrah.

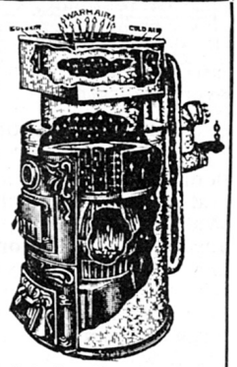
The geological maps of the country indicate what would appear to be very favorable conditions for the boring of a tunnel, altho progress might be delayed by hot springs.

If we reckon no more than two openings the cost of the Dead Sea tunnel, mostly without masonry, and with a minimum area of 135 square feet (or having a diameter of about 13 feet), might be estimated at nearly $40,000,000. To this should be added the cost of the power plant, factory works, canals, other irrigation work and the salt works. The interest on and the amortizement of a capital of about $60,000,000 must be distributed over all these concerns. If the technical works (lime nitrat, salt, distribution of electric power, etc.) are charged with one-half of this amount and the other half to be charged to forestry, agriculture and horticulture, a rough estimate based on the incomplete data so far available will show that this plan does not compare at all unfavorably with the irrigation works constructed in Asia and America in the past decade.

Mr. Hjorth's plans have met with great sympathy among leading scientific authorities and practical technicists in Norway, and the latter have come to the conclusion that such an enterprise as this is not only to be considered as technically feasible, but that it will in all probability be a financial success.

½ SAVED
GET OUR BIG BOOK

DO YOUR OWN PLUMBING AND HEATING AT LOW COST



Any handy man can install a complete plumbing or heating plant in his own home by our new easy method. Every part comes Cut-to-Fit your needs. Our Engineers draw your plans. You can easily do the rest with a few simple tools. You save time, labor and unused materials.

SEND FOR HANDY MAN BOOK

This big book tells you what to install and how to install it. It shows over 10,000 different fixtures at wholesale prices. Every builder, home owner, carpenter or contractor needs one. Save the high cost of labor on needed improvements. We have spared no time or expense in the preparation of this valuable book. To keep from sending it broadcast to uninterested persons we request a temporary deposit of 25c which will be refunded on your first order. Send for it Today.

BURN LESS COAL

and heat the whole house with an improved all-cast pipeless furnace. No expensive pipes or heating equipment. Makes mussy, unsightly stoves unnecessary. Costs no more than a stove. Can be installed in a day by anyone. They are described at wholesale prices in The Handy Man Book. Send for it today.

HARDIN-LAVIN CO.
2630-C Cottage Grove Ave., Chicago, Ill.
We Guarantee Our Every Product

$25.00 FOR THIS
MADE TO YOUR MEASURE
ALL WOOL SUIT

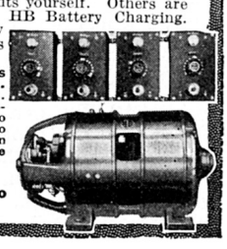
Every suit made to individual measure from the exact fabric you select and according to your exact specifications. We ship it on approval, delivery charges prepaid, for you to try on, to inspect and examine. Unless you are well pleased your trial order will not cost you a cent.

BIG CATALOG FREE Send postal today for copy of our big catalog and style book with 52 cloth samples of the very finest, high grade fabrics and latest, New York and Chicago styles. It shows how any member of your family can take your measures. We guarantee a perfect fit. By dealing direct with us, the manufacturers, you save the unnecessary expense and profit of agents and obtain the very highest grade of tailoring at a saving of 25% to 40%. Write today for catalog and information.

The BELL Tailors
THE BELL TAILORS
Adams at Green Street, Dept. 455, Chicago, Illinois

Battery Charging Your Biggest Money-Maker

$150 to $350 Clear Profit a Month with this HB-32 Battery Charger. You can recharge 32 6-volt auto batteries, or equivalent in 12- or 24-volt batteries, at one time, for 10c to 15c each. Customer pays 75c to $1.50. Figure the profits yourself. Others are making BIG PROFITS with HB Battery Charging. Why not YOU? Get busy NOW—add those extra profits to your income.



Small Investment Puts This Money-Maker in Your Garage. Balance on easy monthly terms. Outfit easily pays for itself. Absolute Money-back Guarantee. No burn-outs, or renewals. Easy to install and operate. Only attention needed is occasional oiling. Write TODAY for full information.

Hobart Brothers Company
Box 23 E Troy, Ohio
Successful Mfrs. since 1893

Perpetual Motion Contest Awards

(*Continued from page* 1013)

THE GENTLE SEX IS AWARDED A PRIZE OF ONE SUBSCRIPTION.

Scheme 1. Does the guide rod run thru the center of the air chamber or is there a separate compartment for the guide rod separating it from the air chamber? If the first case is true, then the air chamber is *not* air tight and the rubber will not be distended to begin with. If the second case is true and the air chambers are air tight, then these rubber chambers could not collapse. In either case there would be equal buoyancy on both sides and there would be no motion whatever.

Scheme 2. If there were no "appreciable leakage" the balls would fit so tightly in the tube that the friction could not be overcome by buoyancy. Even if this were not so, the ball just entering the tube has the weight of the whole column of liquid upon it. This downward force would be too great to be overcome by the buoyancy on the other balls and the comparatively small amount of gravity on the outer balls.

Scheme 3. When the north pole of the bar magnet is at "a", it will move to the *left*, as it is driven away by the north pole and at the same time attracted by the south pole. When it reaches this first south pole to the left, it will remain stock still, as there will be repulsion from the two nearest north poles in the same direction in which the south pole attracts it.

HANNAH DVORCEF,
26 St. Paul St., Montpelier, Vt.

NOT BAD FOR 13 YEARS—PRIZE ONE SUBSCRIPTION.

The three ideas for perpetual motion illustrated in November issue will not "work" for the following reasons:

Idea No. 1. When the expansive rubber chambers, having come down on the right side, run over the pulley, they are supposed to fill with air in the centre of a tank of H_2O, that is, *"where no air is."*

Idea No. 2. When the hollow copper balls enter the tank of water, at the bottom, all the weight of water in the tank is pressing down on top of them. This would counterbalance any effect of buoyancy on the balls forcing them to drop, thereby driving the arrangement in the direction *opposite* to that intended. The water passing thru the tube, in the hollows between the balls, would soon empty the tank.

Idea No. 3. The north pole of the free magnet resting at A would be attracted more by the south pole of the top left-hand magnet, than by that of the top right-hand magnet, owing to the former being nearer; also the north pole of the top left-hand magnet repels the free one back to A, then the free magnet going toward D would stop opposite the south pole of the left-hand magnet, any momentum it might have acquired being counteracted by the repulsion of the north pole of the one at the bottom.

R. HOPE, (Age 13.)
376 20th St. W., North Vancouver, B. C., Canada.

A "SWINING MEGNET"—SPECIAL PRIZE 1C. POSTAGE STAMP.

My answer to figure one is the air chambers when empty as shone on the right hand when it reaches the bottom and starts up it will fill with water insted of air because there is no air in the tank. The air is all forsed out as the chamber desends.

The Things That Bigger Pay Will Bring You

You want these things and probably many others, so why don't you double and treble your pay? **You can do it.** With double and treble the amount you are now earning you can go to the bank each pay day and put away a sum of money for a "rainy day," or that can be used for profitable investments or building your own home. Bigger pay would enable you to own an automobile and to get many pleasures out of life that you cannot now afford. To be able to go to the bank each pay day and steadily build up a bank account **without missing it** is alone worth any effort it may take to increase your earning power. Then think of the things you want that are not pictured here. Whether you ever enjoy those things depends entirely on yourself.

Every day you see men around you stepping up into better jobs and drawing bigger pay. It isn't a question of "how do they do it?" You know they have trained themselves to handle the jobs ahead of them. The question is "WHY DON'T YOU DO IT?" You want the things that better pay will bring you so why not decide NOW to prepare yourself for a better job and better pay?

Don't Dodge a Better Job

Promotion and better pay is up to you and not the boss. The big pay checks go to those who can think, act and do things for themselves. Training will make you a master of your work **and place you in the job you want.** There are no two ways about it; while you ignore the benefits of training you are **dodging a better job.** Without interfering with your work you can prepare for bigger pay right in your own home—after supper in some of the hours you now waste. The thousands who have marked and mailed the Coupon to the right have doubled and trebled their pay. That is just what you can do—so do as they did. Send the Coupon.

AMERICAN SCHOOL OF CORRESPONDENCE
Dept. G-262, Chicago

TRAINING THE KEY TO SUCCESS
Please send me booklet and tell me how I can fit myself for position marked X
ASC

.....High School Graduate	.....Employment Manager
.....Western Union Courses	.....Steam Engineer
.....Telephone Engineer	.....Lawyer
.....Draftsman and Designer	.....Business Manager
.....Automobile Engineer	.....Certified Pub. Accountant
.....Automobile Repairman	.....Accountant and Auditor
.....Airplane Mechanic	.....Bookkeeper
.....Fire Insurance Expert	.....Stenographer
.....Sanitary Engineer	.....General Education Course
.....Photoplay Writer	.....Com. School Branches
....Heating and Ventilating Engineer	.....Electrical Engineer
	.....Electric Light and Power Superintendent
.....Master Plumber	.....Hydroelectric Engineer
.....Civil Engineer	.....Wireless Operator
.....Structural Engineer	.....Architect
.....Mechanical Engineer	.....Building Contractor
.....Shop Superintendent	(.....Foreman's Training Course)

Name .....

Address .....

Stop Snuffling

Sneezing, hawking, spitting and coughing. Why do you have catarrh anyway? You were not born with catarrh—you contracted it. This offensive, unwholesome, disagreeable complaint fastened itself upon you and grew. Nature in trying to prevent more serious consequences due to the congestion in your body, finds an outlet for the accumulated waste, by way of catarrh. You cannot get rid of it the way you are going—sprays, lotions, snuffing powders, drugs and medicines won't stop it. You know catarrh leads to other troubles—serious ones—throat, lungs, stomach, intestines—all become affected. You can never enjoy good health if you have catarrh; you won't be efficient in anything as long as you have catarrh, and it detracts from your personality to be hawking and snuffling around others.

STRONGFORT
The Perfect Man

Build Yourself Up

Be Clean—Wholesome—Healthy—Virile. Go at it the right way—Nature's way; no drugs, no medicines, and you banish catarrh from your system. Let me show you how by my method of health building, body developing, called

STRONGFORTISM

Its practice never fails—it builds new tissue, gives brawn and muscle, it invigorates heart action, strengthens kidneys, and makes the bowels move by their own natural strength, it makes every organ in your body pulsate to health. Under this kind of influence, catarrh quits for good, so will constipation, indigestion, nervousness, palpitation, rupture, rheumatism, weak heart, poor memory, physical weakness, vital losses, short wind, and all sorts and kinds of ailments and disorders.

If you are too stout or too thin, flat chested, or round shouldered—Strongfortism will alter it. It will make you grow in vigor and virility—and nervous energy—it will restore your vitality and keep your forces vital. No matter what your condition is now,—I will show that you can renew yourself. You want to be strong, healthy—a virile man—you want to be all that a man ought to be and I can and will show you how to make yourself the man that is desirable from every standpoint.

Tell me your ailment and send three 2c stamps to cover mailing expenses and I will send you my book **"Promotion and Conservation of Health, Strength and Mental Energy,"** written for your interest and welfare.

LIONEL STRONGFORT

Physical and Health Specialist
1161 Strongfort Institute, Newark, N. J.

Don't Wear a Truss

BROOKS APPLIANCE, the modern scientific invention, the wonderful new discovery that relieves rupture will be sent on trial. No obnoxious springs or pads. Has automatic Air Cushions. Binds and draws the broken parts together as you would a broken limb. No salves. No lies. Durable, cheap. **Sent on trial to prove it.** Protected by U. S. patents. Catalogue and measure blanks mailed free. Send name and address today.

C. E. BROOKS, 203C. State Street, Marshall, Mich

ARTIST

Earn $25 to $100 per week. Cartooning, illustrating, Designing successfully taught by mail through new instruction method. Entire outfit free to new students. Write today for beautiful new book, "HOW TO BECOME AN ARTIST" and special free offer.

Washington School of Art, Inc.
1478 H St., N.W. Washington, D. C.

My answer to No. 2 is the water the tank will tend to run out the bottom and the heft of the water will hold the hollow stellball in chack.

My answer for No. 3 is all megnets have the same strength the *swining megnet* will go to the megnet and stop and the other megnets will not have strength to pull it away.

LOY COAK,
802 Griswold St., Jackson, Mich.

100 WORDS—HONORABLE MENTION.

My brief answers to your problems are as follows:

No. 1. The pockets being air tight and would therefore remain so there being no way for air to get into the bottom of the tank of water this machine would remain stationary.

No. 2. There would be a great upward pull and also a great pressure at the tube in the stand pipe. It is this pressure which would make this machine stationary.

No. 3. Starting with the upper left corner the pendulum magnet would get no further than said corner as the south pole would attract and the north pole would repel and the pendulum magnet would remain right in the same corner.

Anxiously awaiting the outcome of this contest, I am,

Respectfully,
H. B. TROMBLY,
97½ Worcester Ave., Pasadena, Cal.

HONORABLE MENTION.

Scheme 1. This scheme could not work even if friction is neglected because when the buckets are on the left-hand side and commence to "ascend" the weights will extend the buckets and fill them with water since there is no means to fill them with air. The weight of the water displaced on each side or the buoyancy will therefore be equal; also since the chain is symmetrical the force of gravity on each part will be equal. The total forces will be the same on each side and in opposite directions so the machine will be in neutral equilibrium and not move.

Scheme 2. This plan will not work because we have the forces of gravity on each side equal and opposite; because there is friction of the bearings to be overcome; because power is needed to bend and unbend the rope; because of the large viscous friction of the belt and balls in motion thru the water; because the surface tension would operate to oppose motion; and finally, and this is the most important, if it was possible to construct a water-tight joint around the entrance of the hollow balls in the water the friction would alone be so great as to make motion impossible.

Scheme 3. This plan is unworkable because, admitting that powerful enough, concentrated permanent magnets could be built to cause any appreciable motion, when the pole of the hanging magnet came opposite the south pole of the second magnet it would be held there and there would be no further motion because the strongest force which is acting on it would be this attraction. Also suppose that the free magnet was started at a point between the poles of a single magnet the force would be that of attraction by the south pole and repulsion by the north pole and the motion would have a tendency toward the south pole. Once there, there would be no force causing motion from the pole. There would also be frictional losses in the machine and the difficulty in the construction of magnets which I have mentioned.

ALAN C. ROCKWOOD,
Iowa City, Iowa.

HONORABLE MENTION.

Scheme 1. In order to prevent the weight from rupturing the chamber, when

FREE Bargain Book

Big Scout Knife 60c

A great knife for hunting, camping and all sorts of outdoor work. It comes with a heavy steel blade, finely tempered, with ebonized handle, fitted to your grasp. Genuine leather sheath with slits in the end through which to slip your belt.

Electric MOTOR 99c

A strong, two terminal motor, just the thing for operating light running models and electrical toys. Can be run with one or more dry or wet cell batteries, depending upon the power desired. Made by Gilbert, the famous Boys' Toy Inventor.

Gilbert Miniature Machine Gun $3.75

This machine gun is made like a real one. Has a detachable magazine clip for firing the 12 wooden cartridges that come with it, a steel barrel and stock, roller firing crank, automatic travers full circle swivel, wood fore legs and trail. The price is $3.75.

FLASHLIGHT Pocket Size Special 39c

Fits in your vest pocket, ready for service when you need a strong light. Comes with a nickel plated case, equipped with a bright bulb and a two cell battery.

Wonderful Submarine $1.50

Lots of fun to watch the little "sub" performing all sorts of stunts in the water. It is adjustable for diving and circling, either under the water or above. Operates with a strong rubber band motor.

Catalogue FREE *When ordering remit full amount in currency, postoffice or money order, or 2c stamps (not waxed paper between them). We pay all postage and express charges. Your Money Back If You Are Not Satisfied. Address*

BALTIMORE MAIL ORDER COMPANY
Dept. 117 Howard & Baltimore Sts., Baltimore, Md.

ELECTRICAL—FIRES

are feared by all fire fighters. Water or ordinary chemicals are dangerous to use and have no effect on fire. A

NU-EX FIRE-KILLER

breaks electrical arcs and extinguishes the fire instantly. It can be directed into electrical machinery without damage to apparatus or injury to operator.

Write for Our Agency or Distributors Plan

THE NU-EX FIRE APPLIANCE CO.
COLUMBUS, OHIO

LEARN LANGUAGES

AT THE

BERLITZ SCHOOL

28-30 WEST 34th STREET
Brooklyn, 218-230 Livingston Street

Washington, Boston, Philadelphia, Detroit, Chicago, Baltimore, Orange, Havana, Rio de Janeiro, Buenos Aires, Sao Paola, Cordoba, Paris, London, Madrid, Rome, etc., etc.

FRENCH, GERMAN, SPANISH, ITALIAN, &c., &c.

By the Berlitz Method students learn not only to read and write, but especially to understand and to speak the foreign language.
TRIAL LESSONS FREE

inverted, a force is necessary. This is supplied by two agents; first, the tension in the rubber, and second, the pressure of the water above and below the chamber has the effect of a clamp which tends to close it. If the tension plus this "clamp" is insufficient to keep the chamber closed it will open until the increased tension (Hookes Law) plus the increase in the "clamp," due to the increase in displacement, is sufficient to prevent further opening. This increase in the "clamp" is equal to the weight of the additional liquid displaced and is therefore the additional buoyancy sought (Principle of Archimedes). However, it will be seen that this increase of buoyancy is used wholly to aid in the prevention of a rupture of the chamber that *it in no way lessens the downward pull on the belt.* Hence the machine will not run.

Scheme 2. The upward force depended upon to run this machine is the buoyancy of the balls, and is therefore equal to the combined weight of the liquid displaced by them. However, the entrance of the balls into the tank is resisted by the pressure of the water and is therefore equal to the weight of the column of water above the entrance. It is easily seen that this downward force will be greater than the upward force, so instead of the machine running as wished, it would, neglecting friction, run backwards until the tank was emptied, in this case running at the expense of the potential energy of the stored water. Hence the failure of this one.

Scheme 3. Suppose we start the suspended north pole to swing from d to a. In so swinging it would be attracted by the south pole at a and repelled by the north pole at d. But altho its inertia might carry it as far as the vertex a it would go no farther, for the south pole would attract it and the north pole repel it so as to cause it to return towards d and thus oscillate between the two vertexes like a pendulum. Thus comes the failure of the third machine.

Q. E. D.

NOTE: These machines are similar to all other "perpetual motion" machines in that all details are perfected *except that they won't work.* And rightly so for they are in direct contradiction of the principle that energy can neither be *created* or destroyed by human agents.

DANA P. MITCHELL,
Angola, Indiana.

Honorable Mention.

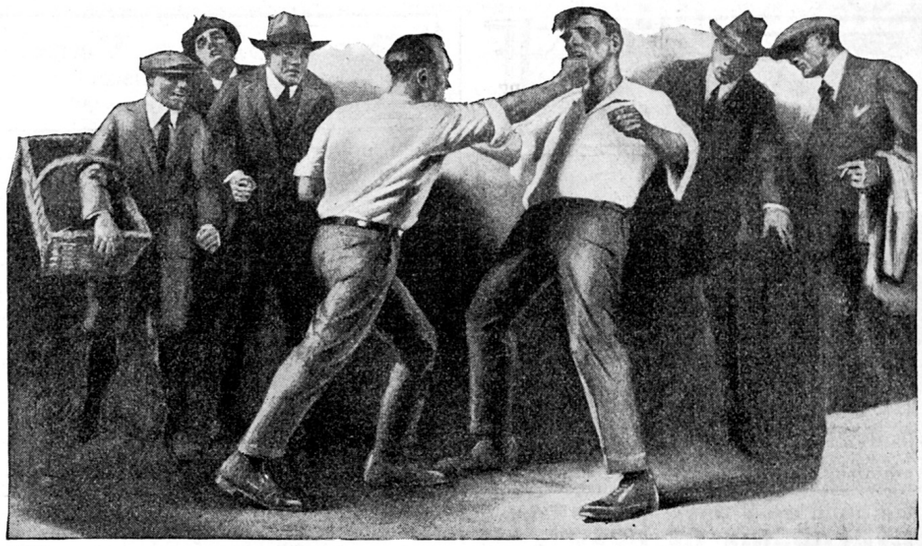
Theoretically the three so-called perpetual motion machines described in your November issue may be all right. But——

No. 1 will not work because the dropping of the weights, which is supposed to distend the rubber air sacks would tend to create a vacuum and cause the sacks to fill with water. There is no way for air to get into the sacks.

No. 2 will not work for the reason that the opening in the bottom of the water tank corresponds to a cylinder, and the buoyancy of the balls would not be sufficient to overcome the weight of the water. If the machine ran at all, it would run backwards. It would do that only so long as the tank was kept filled with water.

No. 3 will not work because, as the swinging magnet's north pole reaches one of the corners it would have to pass a north pole of stationary magnet in order to continue its journey. The pull would be exactly equal to the push, with the result that the suspended magnet would have to be assisted over the "dead center."

EARLE M. PETTIT, D.C.
Niagara Falls, N. Y.



When this test comes to you, it won't be a question of how brave or strong you are, but whether you know how to defend yourself.

Brave but helpless!

DEEP down in your heart you know if you were called upon tonight to defend a loved one, you couldn't play the part. That if a bully spoke insultingly to your mother, sister or sweetheart, you couldn't teach him a lesson. That if you were attacked on a dark road or lonely street you couldn't overcome your opponent.

You're not a coward; it isn't that—but you don't *know how.* When your test comes, as it does to every man, it isn't going to be just a question of whether you are brave or not, but whether you know how to box, how to defend yourself against bone-breaking and jiu-jitsu holds, how to disarm an opponent, how to stop the kick he launches at your stomach, etc.

Now, don't you see that in justice to those who look to you for protection, it is your duty not only to be *willing,* but *able* to play a man's part when the time comes? The excuse that it takes too long, or that you haven't the time, or the money, no longer holds good; for boxing and self-defense are being taught successfully by mail to over 10,000 pupils—*at less than half the cost of the usual term of lessons by the old method.*

Just as scientific teaching has reduced the time of learning how to swim to two or three lessons, so the Marshall Stillman "Shortcut" method has reduced the teaching of boxing to five lessons. The instruction takes place before your own mirror, so that you learn the rudiments (the hit, guard, duck, feint, clinch, and foot-work) before you face your first opponent. You are not confused while learning by the superior knowledge of an opponent who knows how. On the contrary, the very first time you go up against your opponent, you will know how to hit him, what to expect in return, and how to guard against it.

In a few more lessons you quickly learn how to disarm an opponent and how to get out of dangerous and bone-breaking holds.

To show you how simple the lessons are, we quote the instructions on how to break an opponent's strangle-hold on your throat: "If your opponent has both hands on your throat and is choking you, don't try to choke him, don't pull his wrists, and don't try to hit him. Simply reach up with your two hands and take hold of his two little fingers (they are easy to get at) and give them a quick bend backwards; break them if necessary; he will let go immediately."

Simple, isn't it? So are all the lessons in the Marshall Stillman course. Marshall Stillman has been a student of boxing and self-defense for thirty years. He was friend and pupil of Professor Mike Donovan, undefeated middleweight champion of the world. Together they created the Marshall Stillman course as it is now taught by mail, Mike Donovan personally posing for the illustrations. For the past 10 years Marshall Stillman has concentrated on simplifying the instructions, until today, anybody, man or boy, can learn easily and quickly by mail.

Now, we suppose you are like many others—you still don't believe that boxing can be taught by mail, because you never heard of its being done before. All right. We are willing to prove it to you. We will mail you the complete course on five-day approval. You don't have to send any money or references. Simply fill in and mail the coupon below. If you keep the course, remit the special introductory price of $5.00 (formerly $10) within five days.

The complete course includes:

5 lessons in boxing, the hit, guard, duck, clinch and feint, and foot-work.
1 set of daily exercises to keep you in good condition.
3 rounds of shadow boxing.
8 bone-breaking or jiu-jitsu holds and releases.
8 holds in standing wrestling.
1 free copy of Professor Donovan's book, "The Science of Boxing," illustrating and describing practically every good blow and guard known to the ring.

In the face of rising costs, we cannot promise to maintain this special introductory price indefinitely, so if you are at all interested mail the coupon immediately to the Marshall Stillman Association, Suite E-2, No. 461 Fourth Ave., New York.

Free Trial Coupon

Marshall Stillman Association, Suite E-2, No. 461 Fourth Ave., New York

You may send to the name and address written on margin below the complete Marshall Stillman course in boxing and self-defense as described above on five-day approval at your risk. I will either return it or remit the special introductory price of $5 within five days.

Be a Draftsman!

Make $30 to $75 a Week

Your name and address on the coupon brings this great Cyclopedia of Drawing without a penny down. Pay only net shipping charges when books arrive. With these books and a low price "school set" of drawing instruments, obtainable at any store, a man can become master of drawing and earn $30 to $75 weekly.

LEARN AT HOME—Good paying positions open everywhere. Intense activity in manufacturing, railroading, building, etc., calls for more draftsmen.

Shipped on 7 Days' FREE Trial

CYCLOPEDIA OF DRAWING

4 Volumes. 1650 Pages. Thousands of Illustrations.

Bound in genuine American morocco. Pages 5½ x 8½ inches. Covers all branches of Drafting—Architecture, Electrical, Structural Steel, Sheet Metal, etc. Teaches pen-and-ink rendering, lettering, free-hand, perspective, shades and shadows, working shop drawings, machine design, etc., etc.

50c a Week Only $2 a month if you keep the books. Coupon explains offer, good only within borders of U. S. and Canada.

Free Membership in This Society.—A Consulting Membership **given free** with each set—worth $12.00.

AMERICAN TECHNICAL SOCIETY
Dept. D-252 Chicago

AMERICAN TECHNICAL SOCIETY
Dept. D-252
Chicago, U. S. A.

Please send Cyclopedia of Drawing for 7 days' examination, shipping charges collect. I will send $2.80 within 7 days and $2 a month until $14.80 is paid, or notify you and hold books subject to your order. Title not to pass until fully paid.

Name .....
Address .....
Reference .....

BE AN EXPERT

Auto and Tractor Mechanic
Earn $100 to $400 a Month

Young man, are you mechanically inclined? Come to the Sweeney School. Learn to be an expert. I teach with tools not books. Do the work yourself, that's the secret of the

SWEENEY SYSTEM

of practical training by which 5,000 soldiers were trained for U. S. Government and over 20,000 expert mechanics. Learn in a few weeks; no previous experience necessary.

FREE Write today for illustrated free catalog showing hundreds of pictures men working in new Million Dollar Trade School.

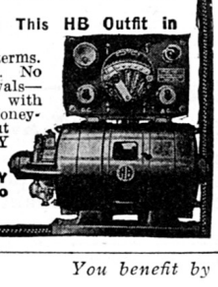
LEARN A TRADE
Sweeney
SCHOOL OF AUTO-TRACTOR-AVIATION
66 SWEENEY BLDG. KANSAS CITY, MO.

HB BATTERY CHARGING PAYS BIG PROFITS

$100 to $200 CLEAR EXTRA PROFIT Each Month

Recharges 1 to 8 6-volt batteries at once for 10c to 15c each. Owner pays 75c to $1.50. Figure those profits! You can build a big, profitable business in battery charging. No mechanical knowledge required. Small investment—long easy terms—BIG PROFITS

Small Cash Payment Puts This HB Outfit in Your Shop



Balance on easy monthly terms. Profits easily carry payments. No burnouts, no expensive renewals—steady, dependable service with BIG Profits. Absolute Money-Back Guarantee. Tear out this ad and mail TODAY for information.

HOBART BROTHERS COMPANY
Box 21 E Troy, Ohio
Successful Mfrs. Since 1893

The Golden Vapor

By E. H. JOHNSON

(*Continued from page 997*)

stopt under a lamp, pulled out his lately acquired paper, read and re-read something in it, and finally with all the appearance of one who enjoys the contemplation of a master joke that he has engineered, he thrust it once more deep within his pocket, seized his coat by the lapels, pulled himself up, and chuckled,—actually chuckled, tho a careful examination of another paper identical with the one he carried, failed to reveal the slightest cause for such behavior.

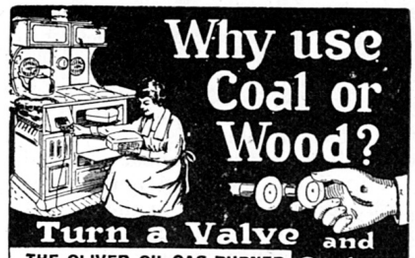
Then slowly he wandered on thru the higher residence portions of the city, occasionally whistling in a rambling way,—aimlessly it seemed, even like his own wandering. But the frequent repetition of a few notes suggested the unconscious echoing of some song of other days. They were, however, unheeded by the few who were still awake, save one, an old night watchman, in whom the peculiar strains had suddenly awakened strange memories. He seemed to be once more leaning from the little window in his father's house in a land once dear to him, but which he had come to regard as no longer first in his affections, now that he was an American. With each repetition of those haunting strains he could almost hear the tramp, tramp of the gay *Studenten*, as they sang late into the night. There was no mistaking it, and for the first time in a score of years the words came back to him:

"Alt Heidelberg, du feine,
Du Stadt an Ehren reich,
Am Neckar und am Rheine
Keine andre kommet dir gleich."

No mistake! Old Heidelberg, even the lilt at the end of each line had been common to the students in old Heidelberg. Who ever it was that thus whistled away the midnight hours, he was either a native of Germany or one of those Americans who had long studied there. And in spite of his recent feeling of shame because of his own nationality, the old man hastened on around the corner hoping to meet this possible friend, only to see a distant figure vanish into a side street, to be lost entirely as the whistling ceased.

Thus it was that Grieg had wandered about the city—Doctor Grieg, the man with an enviable past and before whom lay limitless opportunity for aiding or upsetting much of the social organization of the years ahead.

As a boy he had grown up in that much disputed and undoubtedly desirable country bearing the poetic name of *Alsace-Lorraine*. Early he had been sent to both the *Realschule* and the Gymnasium, and later by some forgotten bit of fortune had been able to go to Heidelberg, Bonn and Berlin. Here he had studied under some of the greatest of living scientists, Helmoltz among the rest, and he had not only shown unusual ability in mastering the deep mysteries of chemistry and physics, but had on several occasions given evidence of the possession of no common power of insight into natural phenomena. Deep electrical problems had been his chief delight, and it was even suggested that had he cared for notoriety he might have anticipated the great Heinrich Hertz in announcing some of the facts which the latter discovered concerning electromagnetic waves. In 1893 and the years following, he had been back and forth between Paris and some of the German universities where was going on the feverish work immediately preceding the world-stirring announcements of Becquerel and Roentgen. He had followed closely some of the earliest work of the Curies, in their epoch-making isolation of radio-active substances and, at the time (1896-7) when Perrin was trying to gen-



Why use Coal or Wood?

Turn a Valve and Cook or Heat

THE OLIVER OIL-GAS BURNER makes any cooking or heating stove a gas stove. Burns coal oil (kerosene). No coal or wood. Cooks and bakes better. Cheaper. Keeps your home warmer. You regulate flame. **FITS ANY STOVE ANYWHERE.** No fires to start, no ashes, no chopping, shoveling, poking and dragging of coal. Saves hours of work and loads of dirt. Simple. Safe. Easily put in or taken out. No damage to stove. Lasts a lifetime. Thousands of delighted users. In use eight years. Money-Back Guarantee. Free literature

AGENTS WANTED

OLIVER OIL-GAS BURNER & MACHINE CO.,
1345 N. 7th St., St. Louis, Mo.
Western Orders Shipped From Frisco.

The Oliver Oil-Gas Burner makes 2 gals. oil equal 97 lbs. coal

FOR ALL WIRELESS, ELECTRICAL EXPERIMENTING AND WIRING USE

USED BY U. S. AND ALLIED GOVERNMENTS IN WAR

95c PER TUBE

TORCH **$1.25**

A PASTE THAT TURNS INTO METAL WHEN HEATED

A match will do it. Requires no acid or soldering iron. Joins or repairs wires, metals or metalware. Sold by hardware and electrical stores, or sent by us postpaid.

SOLDERALL CO., Dept. 9
129 Sussex Ave., Newark, N. J.

COMBINATION SET Tube and Torch Complete **$1.50**

HANDY

THAT'S the word to describe this new utility chest—the handiest, sturdiest, chest for garage or home use, for auto-mechanics, electricians, plumbers, line-men. Its solid oak frame, rigidly held together by lock-cornered joints—twice as strong as dove-tailing—insures tool safety against theft, rust, bangs, knocks or outdoor weather. Get the details about this chest and the other 18 Union sizes and styles. Write for Catalog, prices and name of nearest dealer and guarantee. If no dealer near you, write for special offer.

Union Tool Chest Co., Inc., 36 Mill Street, Rochester, New York

UNION
TOOL CHESTS

STOP DYING! Practice the Science of Ideal Life Extension and Cure for all Diseases

Thomas, Dr. Mal-Assimilation and its complications	$1.00
Rosch, Dr. Abuse of the Marriage Relation	.50
Lernanto, Dr. Rediscovery of the Lost Fountain of Health and Happiness, for nervous afflictions, nerve-exhaustion, mental ills and sexual diseases	1.00
Erz, True Science and Art of Healing	.50
Lust, B., Dr. The Raw Food Table	.25
Lust, B., Dr. A Conscious Diet for Powerful Health	.25
Lust, B., Dr. Wind and Gases	.25
Just, A. Return to Nature. The book of books	2.00
Current month's issue of **Naturopath and Herald of Health** magazine	.25
The whole combination worth	$6.00
Special to E. E. Readers, postpaid	$2.00

DR. BENEDICT LUST, Naturopathic College and Nature Cure Health Home, Butler, N. J.

A STEFFEY MOTOR

on your wheel will convert it into a practical and successful high grade motorcycle that will cost you less to operate than the more expensive machines. Write at once and secure lowest factory prices. Excellent opportunity for agents. Send stamp.

STEFFEY MFG. CO., Dept. E. 5025 Brown St., Phila. Pa.

158 Genuine Foreign Stamps—Mexico War Issues, Venezuela, Salvador and India Service, Guatemala, China, etc. Only **10**
Finest Approval Sheets 50% to 60%. AGENTS WANTED. Big 72-p. Lists *Free.* **We Buy Stamps.** Established 25 yrs.
Hussman Stamp Co., Dept. **67, St. Louis, Mo.**

erate electric currents by means of the Roentgen rays, Dr. Grieg was not only frequently in London attending meetings of the English scientific societies, but had given a series of lectures before the Philosophical Society of Cambridge on the "Electrical Nature of Matter." These papers, preserved in the transactions of the society, show now perhaps more clearly than they did then the wonderful perspicacity of the man. In a manner worthy of Faraday or Maxwell, he had predicted certain phenomena—or their absence—to be upheld by the work of other investigators a decade later. Especially had he been interested in all electrical experiments conducted in a vacuum, as he was watching for every possible verification of his early theory that any form of matter in a sufficiently divided elementary form—atoms or their subdivisions—might be transported by electrical forces, like the ray particles investigated by Becquerel and Crookes. Tho this suggestion seemed radically visionary, the experience of the scientific world between 1895 and 1900 had taught it to reserve judgment. Only after a certain familiarity with the newer rays and radiations had been acquired did men of science once more venture to make dogmatic statements relative to possible natural phenomena. Then they had condemned Grieg as a notoriety seeker, and owing to the fact that at that time he was not holding any high academic position, he had little recourse in his adversity. But his resolve to prove his point doubled from that time on. It became the dominating passion of his life to show that his critics were wrong. To strengthen his own conviction further work was unnecessary. He would yet demonstrate to the world a transformation more wonderful than any for which the philosopher's stone had ever been sought.

Then it was, about 1902, that he turned to America. Hurt but far from crushed, he resolved to leave the blind leaders of the old world, and come to the land of golden opportunity. As his controversies in Europe had been largely over matters of opinion, his distinction in this country was scarcely if at all diminished, and he was immediately offered the chair of electrochemistry in several of the eastern universities. But after a few special lectures before some of the scientific societies in the eastern states he continued his journey westward, finally to settle down in the sunkist city of San Francisco. Here the western spirit of youthful enthusiasm inspired him as nothing else had since his student days in Bonn. He found everyone ready to accept a newcomer at his apparent worth, with no questions about the past, and requiring no promise for the future.

He now rented a few rooms, gathered his books about him and began a period of study and experimentation more intense, if possible, than any of his earlier years. Aside from the postman with his armful of scientific journals and letters from foreign savants, he had no visitors; no one knew anything of his order of life. Days and nights lost all distinction for him. Rest came only when sorely needed and with no relation whatever to the time of day or the custom of those about him. He lived as in a prison, glad that its doors locked out the entire world of possible disturbers.

During the years that followed Dr. Grieg gradually felt his way along the path of which he had dreamed while yet a student. Every fact, every relation between the phenomena of molecular physics, brought him nearer his desired goal. While a mere boy he had read with wild interest of the ancient experiments in which water inclosed in gold and silver spheres had been made to actually pass thru the pores of the metal when subjected to sufficient pressure.

Learn Public Speaking

10 LESSONS FREE

Write — quick — for particulars of this extraordinary offer; an opportunity you will never forget if you take advantage of it. Ten lessons in effective public speaking absolutely FREE to those who act promptly, to introduce our course in localities where it is not already known.

We teach you by mail to become a powerful and convincing speaker—to influence and dominate the decisions of one man or an audience of a thousand. We have trained hundreds and helped them to increase their earnings and their popularity. Learn, in your spare time at home, how to overcome "stage fright" and conquer fear of others; how to enlarge your vocabulary; how to develop self-confidence and the qualities of leadership; how to RULE others by the power of your speech alone; how to train your memory. Our

WHAT THE COURSE TEACHES YOU.

How to talk before your club or lodge;
How to address board meetings;
How to propose and respond to toasts;
How to make a political speech;
How to tell entertaining stories;
How to make after-dinner speeches;
How to converse interestingly;
How to write better letters;
How to sell more goods;
How to train your memory;
How to enlarge your vocabulary;
How to develop self-confidence;
How to acquire a winning personality;
How to strengthen your will power and ambition;
How to become a clear, accurate thinker;
How to develop your power of concentration;
How to be the master of any situation.

New Easy Method

perfected and taught only by Prof. R. E. Pattison Kline, former Dean of the Public Speaking Department of the Columbia College of Expression, can be learned in 15 minutes a day. Prof. Kline is one of the foremost authorities in the country on public speaking and mental development. Do not let this chance escape you.

Offer Limited

Send This Free Coupon Now

This Special Offer of TEN LESSONS FREE is made strictly for advertising purposes and will be withdrawn without notice. Write now, before it expires, and receive full particulars with enrollment blank by return mail. No obligations of any kind. Just tear off and mail this free coupon—or a postal will do.

FREE LESSONS COUPON

North American Institute,
7442 Manhattan Building, Chicago

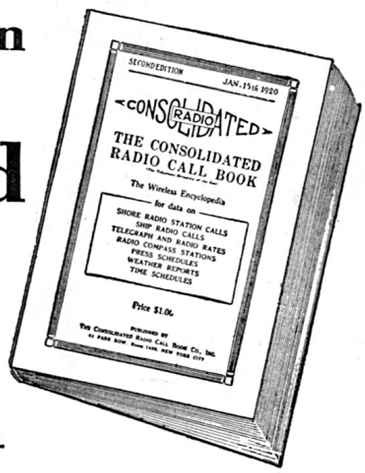
I am interested in your course in Effective Public Speaking and your offer of ten lessons free. Please send particulars. It is understood that this request places me under no obligation of any kind.

.....

.....

WIRELESS MEN and AMATEURS

The Second Edition of the Consolidated Radio Call Book



The only book in print officially listing all the amateur radio calls as issued by the Bureau of Commerce. Meets a timely and urgent necessity among radio and steamship companies, professional and amateur radio operators, and those having need of authentic and practical information on radio calls; radio, telegraph and cable rates, special signals and general radio procedure.

All Amateur Calls Listed

In addition every vessel and land station in the world is represented and listed alphabetically, according to names of vessels or land stations, and according to call letters; Revision of American coastal stations under U. S. Naval control, and their new calls.

That new and great aid to navigation—the radio compass—is explained and is a unique feature of this publication which will be of special value to masters of merchant vessels. This book contains all calls listed in the new book to be published by the Department of Commerce.

Price $1.00 Prepaid

IMPORTANT NEW

Given Free with Each Copy

A Wireless Map of the World **in colors** is given absolutely free with each copy. This map shows the locations of all the high powered RADIO stations in the world, including the time signal stations. In addition it tells at a glance how far away any of these stations are. Of greater interest are the time zones, which enable the amateur to compute instantly the correct time for the zone in which he is located from any time signal station.

Order Your Copy Today

Send Cash, Money Order or Check. Act quickly, as orders are pouring in and the edition will be rapidly exhausted. All orders filled in the order of their receipt and first come, first served.

Consolidated Radio Call Book Co., Inc.
41 Park Row, New York City

This book also contains the advertisements of practically every leading company in the radio field.

Why might not the same thing be accomplished by some other force than a mechanical one,—by an electric or a magnetic force, for instance? He had also followed the well-known experiments on the diffusion of metals, in which molecules of gold and lead had mixed when blocks of the pure substances had been kept in close contact for a long time. Here the materials, in small portions to be sure, had migrated under some influence broadly classified under molecular forces. Were these too not electrical? Could they not be controlled artificially?

Then later there were the remarkable experiments of Bridgman, in this country, and Adams and others in England, which had shown that the ordinary characterizing properties of all substances disappear or change radically when suitable forces are applied to them. He had seen the rock specimens produced by Adams, proving that solid, cold granite could be made to change its form and flow by the mere application of sufficient pressure. He had studied Bridgman's data showing that liquids may behave as solids, and vice versa, if confined and subjected to forces of great enough magnitude. And many of their other physical properties were changed to such an extent as to afford a new field of knowledge.

All of this came to Grieg as welcome support for his theories. Each discovery by another enabled him to shorten his own methods for arriving at his goal. He recalled the famous experiments on electricity and the ether, by Sir Oliver Lodge and others, and the later theories about electrons filled him with ecstasies of joy. Other investigators as well as himself were finding out that atoms of matter when in vibration at a sufficiently high rate, had some effect on the ether of space; they actually sent out waves, and in some cases they themselves disappeared as if borne away on the rays of energy they had emitted—radiations actually affecting certain electrical instruments. Soon it was found that as these electrical properties of matter were made to increase, many of the other ordinary "substance" characteristics diminished or disappeared entirely. The identity of some of the "rays" from radio-active substances and atoms of helium had long been suspected, and it only remained to produce such a separation and transfer of matter artificially to overcome the great difficulty which was temporarily threatening all of Dr. Grieg's hopes. He must make atoms,—atoms of helium, for instance, do some of the things that the alpha-particles of radium had been shown to do. Perhaps it might be possible to do even more.

Of the experimental details involved in this attempt little can be told. Naturally the apparatus used was complex and delicate. Dr. Grieg's rooms had gradually taken on the confused appearance of living room, library and laboratory. In the larger room of the three which now constituted this "little kingdom," was a long table covered high with a mysterious conglomeration of instruments, glass tubes, bulbs of quartz and other substances, an electrically driven vacuum pump, and a MacLeod gage for showing the exact degree of vacuum obtained. There were also wires, switches, rheostats and electrical meters in great numbers, a hopeless mix-up to the uninitiated, but to the master—to Grieg—all was undoubtedly in precise order, in pleasingly fine adjustment—a thing alive, a creature of promise!

Of this mass of equipment several portions were conspicuous beyond the rest. Mounted near the center of the table was a semi-transparent globe, apparently of glass and tinted faintly to a lemon-yellow color. From above it was joined by a tube to the gage and pump, and below it tapered to a neck provided with a glass stop-cock.

On opposite sides entered two wires which seemed to terminate in small concave metal reflectors not unlike the cathodes in early forms of X-ray tubes. These two were identical and seemed as if curved to focus at a common point midway between them. A close observer would have noticed at this focal point a small, bright metal bead, mounted on the end of a fine wire coming from another electrode in the rear wall of the bulb. Externally, these were all connected by wires to the electrical instruments with which the table and the space beneath it was largely filled.

Not far away was a second bulb of about the same size as the former, but containing a large concave mirror of very peculiar appearance. At first sight it would have been taken for metal, like the smaller ones, but closer inspection showed it to be at the same time somewhat of a glassy nature, almost transparent when viewed directly from in front. At its focus were the ends of several tiny wires bearing small frames at once suggestive of the grid arrangement in some of the *vacuum detectors* used in wireless telegraphy. This bulb was not connected to the air pump, but apparently sealed permanently, and supported in such a manner that it could be rotated to face in any direction. Dr. Grieg called the latter bulb the *Medior*, and the other one the *Materializer*. In them lay the secret of his entire work, the result of his years of study, and they were at one and the same time weapons and tools for possible good of previously undreamed of potency.

Long ago he had seen enough of the realization of his dreams to work on in feverish haste. Altho a little thought would have shown that his secret was safe, even had his rooms been open to every one, he lived in a constant tremor of fear, lest his new-found power should slip into the hands of others. Calmly thoughtful by nature, he at times lost all self-control at the very thought of an outsider within his sanctum. And this fear grew day by day until reasons began to formulate themselves in his mind for leaving the house he had come to regard almost as his own, and find other quarters, where there might be no curious land-lady, where walls were not so thin, where fire risk would be less, facilities better, and so on, until, as he surveyed the array he saw clearly that there was no course left him but to move, and the sooner the better.

So it came about that before long a dray load of huge boxes and crates was moved into one of the rear rooms on the second floor of a down-town office building. Grieg had reasoned rightly, that seclusion was more certain in the heart of the city than where people's thoughts were less occupied. Here he had a spacious room, only one to be sure, and one having but two windows high up so as to afford only a view of a few square feet of brick wall a few feet away. But these and other factors were great sources of gratification to the new occupant, and the least of the several reasons for this was that they made the rent far lower than that for any similar space to be found. And the walls, they were of solid brick and masonry, two feet thick if an inch,—and the floor was of concrete. What more could he wish for? Greater security and isolation could scarcely have been provided by a lonely island in Polynesia.

Now it was that the work began in earnest. Dr. Grieg had some months earlier succeeded in transmitting helium from one bulb to another several feet distant by means of his electrical rays. And the method had been surprisingly simple after all of the superfluous details in the apparatus had been eliminated. At first the flask containing the helium had been placed in the path of a powerful beam of ultra-violet rays and the *Medior* bulb immedi-

LEARN WIRELESS AT HOME

The Demand for Wireless Operators Far Exceeds the Supply

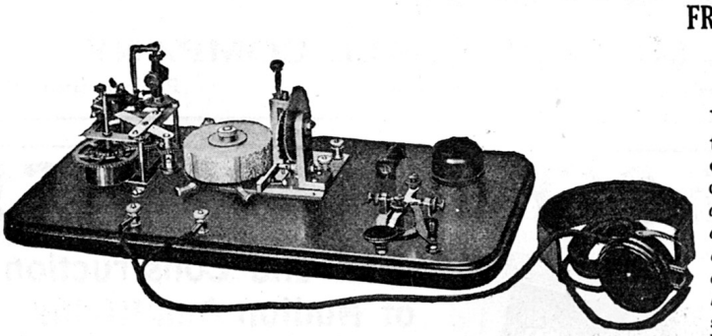
The New York Wireless Institute will make you an operator—AT HOME—in your spare time—quickly, easily and thoroughly. No previous training or experience required. Our Home Study Course has been prepared by Radio Experts. Experts able to impart their practical and technical knowledge to *YOU* in an *easy to understand* way. The graded lessons mailed you will prove so fascinating that you will be eager for the next one. The instruments furnished *free,* will make it as easy to learn the Code as it was to learn to talk. *All you will have to do,* is to listen.

Big Salaries

Wireless operators receive excellent salaries ranging from $125 to $200 a month and it is only a stepping stone to better positions. There is practically no limit to your earning power. Men who but yesterday were Wireless Operators are now holding positions as Radio Engineers, Radio Inspectors, Radio Salesmen at salaries up to $5000 a year.

Travel the World Over

A Wireless Operator can visit all parts of the world and receive fine pay and maintenance at the same time. Do you prefer a steady position without travel? There are many opportunities at the numerous land stations or with the Commercial Wireless or with the Steamship Companies.



This wonderful Set for learning the Code furnished free with our Course

FREE Instruments and Text Books

We furnish free to all students, during the course, *the wonderful receiving and sending set exactly as produced in the illustration.* **This set is not loaned, but *given* to all students completing the Course.**

The Transmitter shown is the celebrated *Omnigraph* used by several Departments of the U. S. Government and by the leading Universities, Colleges, Technical and Telegraph Schools throughout the U. S. and Canada. Start the *Omnigraph,* place the phone to your ear and this remarkable invention will send you Wireless Messages, the same as though you were receiving them, through the air, from a Wireless Station hundreds of miles away. When you apply for your license, the U. S. Government will test you with the *Omnigraph*—the same model *Omnigraph* as we furnish to our students. Ask any U. S. Radio Inspector to verify this.

FREE Post-Graduate Course

A one month's Post-Graduate Course, if you so desire, at one of the largest Wireless Schools in N. Y. City. New York—the Wonder City—the largest port in the World and the Headquarters of every leading Wireless and Steamship Company.

Easy Payments

A small payment down will enroll you. We will make the payments so easy that anyone ambitious to enter the fastest growing profession—Wireless—may do so.

Send for FREE Booklet

Without obligating you in any way, send for our booklet "How to Become an Expert Wireless Operator"—it is free. Mail the coupon below, or postal or letter—*but do it today.*

NEW YORK WIRELESS INSTITUTE
Dept. 81, 258 Broadway
New York City

New York Wireless Institute
Dept. 81, 258 B'way, N. Y. City

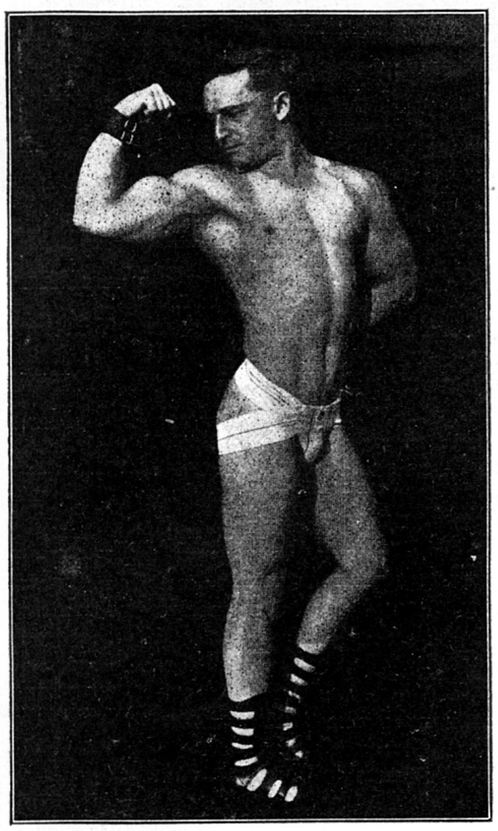
Send me free of charge, your booklet "How to Become an Expert Wireless Operator," containing full particulars of your Course, including your *Free Instrument Offer.*

Name .....

Address .....

City or Town.....State.....

The Benefits of Good Health



The obvious benefits of good health are not its only advantages. Good health is a controlling factor in the success and happiness of all its possessors. The man who is chronically ill, or even who is chronically a little below par, finds himself seriously handicapped.

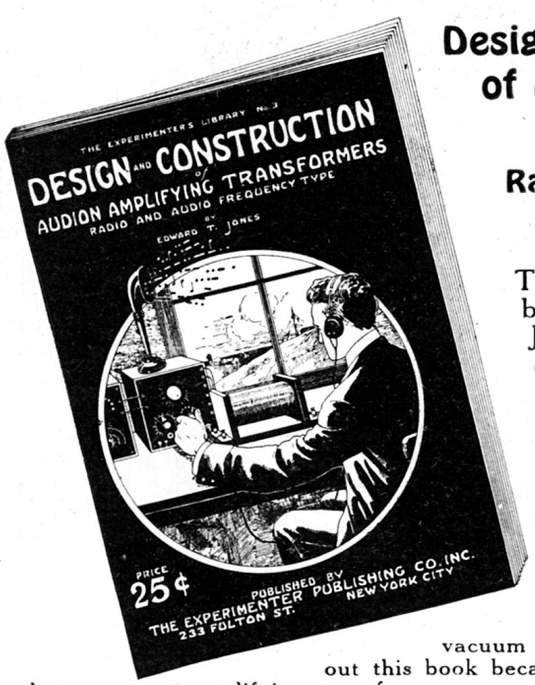
Proper circulation and the daily use of the lungs to the full capacity will make a remarkable difference in your health, and through your health you gain your happiness and general efficiency.

Your health is the most valuable of all your possessions. Everything else depends on it. Do not neglect it. Send for our free illustrated catalog and folder No. 18 describing our system of exercise.

THE MILO BAR BELL COMPANY

Diamond & Third Sts. Dept. 3 Philadelphia, Pa.

JUST OFF THE PRESS!



Design and Construction of Audion Amplifying Transformers

Radio and Audio Frequency Type

This latest and important book by Mr. Edward T. Jones, late Associate Editor of Radio News, will be of great interest to all radio amateurs thruout the land. The transformers shown in these books have never been described in print before, and have usually been considered a manufacturer's secret.

Anyone who has several vacuum tubes cannot afford to do without this book because it will enable him to build the necessary amplifying transformers very readily. The designs are very simple and rugged, and anybody can make them without much trouble whatsoever.

Mr. Jones, the author, is a practical man, who is an experimenter himself, and knows whereof he speaks. The book is printed on good paper and has an attractive cover in two colors. Paper bound. Size, 5" x 7". Contains many illustrations, diagrams and working data necessary to build the transformers.

PRICE Postpaid, 25c.

Experimenter Publishing Co., Book Dept. 231A Fulton St., New York, N. Y.

ately in front of it in the same rays. Then, when the proper pressures were obtained in the two containers, he had succeeded in showing by means of the spectroscope that the space within the *Medior* contained a small percentage of helium, whereas before the exposure it had contained absolutely none.

From that time on the developments were of the nature of slight adjustments and improvements rather than fundamental inventions. He now had the embryo of the creation which he fully believed could be made to grow to almost any proportions if properly studied and assisted. Before his mind's eye lay a changing universe, its laws upset, and all human notions of its stability and fixity set at nought. If helium, for example, could be thus called by him from one closed vessel and made to appear within another, when there was no apparent physical connection or functioning medium between them, why might not his command be extended to all other elements as well?

One evening while sitting far into the night and gazing at his beloved bulbs, as he had often done before, but now as one hypnotized and immovable for the first time in many hours, he gradually lost all sense of time and space in contemplating a widening vision that built itself up and up before him. His cheeks became flushed and an unwonted fire glowed in the depths of his half-closed eyes and, drunk with the dream as well as exhausted, he fell asleep and dreamed on.

Hour after hour his little clock ticked away the seconds and the little motor that drove the air-pump purred on so contentedly that one would scarcely have dreamed that its song was one of ceaseless labor and faithfulness. Perhaps it knew the importance of its task, and who shall say that the little old clock did not philosophize deeply before ticking off another second, knowing that no power could bring it back.

Suddenly Grieg awoke. He seemed at first startled, as if surprised in some secret business, and then recognizing his whereabouts, he almost laughed aloud. Undoubtedly he would have done so had not his habit of secrecy and quietness become quite fixt. But he did laugh a little, and for a long time as he walked about the room with his hands behind his back he seemed to be reviewing some pleasant scene. He would stop occasionally and caress some queer-looking piece of apparatus, or perhaps he would speak to some other mysterious contrivance, all the time with the bearing of one who was both a general marshalling his troops for a glorious assault and a dear friend. His brief ejaculations were of the nature of assurances, of promises, of congratulations.

That night, or rather morning, Grieg thought no more of sleep. For a time he pored over the books which were scattered about the room,—the most of them open to some reference of immediate interest. Then he renewed his experimental work. For days he scarcely seemed to pause for a moment. When or where he ate is not known. Had he not actually slept amid his apparatus on that other night he might have been credited with perpetual sleeplessness, among his other powers. But thru it all, something seemed to buoy him up, to renew his vigor and instill youth into his veins.

It has long been known that when under the influence of the force of electric currents of sufficiently high frequencies and high potentials, practically all substances act as conductors. This fact had been made use of by Grieg in making the *Medior*. Now he constructed strange transformers for increasing these qualities as far as possible. Huge coils, like those of Tesla and Oudin, were built into the

(*Continued on page* 1069)

In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addrest to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

SPECIAL NOTICE!

Of late we have received so many letters from our correspondents regarding patent advice, that it has been quite impossible to publish all of them.

Altho printed in the smallest type possible, we cannot accommodate more than ten or twelve answers a month. At the present time we are about four months behind. Of course, if our correspondents have time, no harm is done! We would, however, advise that if a quicker answer is wanted, correspondents should avail themselves of our special service, as per the notice printed at the head of this column.

All letters are answered in turn as they come into this office, and for this reason it will be understood why it takes so long for an answer to be publisht. Will correspondents please bear this in mind?—EDITOR.

Typewriter Device.

(370) Walter C. Leahy, Bogalusa, La., has written the following interesting letter: "I would be very glad to have you publish at your earliest convenience, the prospects of obtaining a patent should the following idea justify one, on a device described below, which, as far as I can ascertain, is entirely original.

This attachment can be used with any design of typewriter or billing machine, to make use of other special characters than just those originally in the machine, without the necessity of removing one of the original keys and inserting the new type-bar with the special character.

This consists of a "shell" made of any spring metal just large enough to snugly fit over the type and containing on its face or printing edge the special character which it is desired to use. Its shape would depend on the shape of the type in the machine, and has to be made "springy" enough to hold firm to the type-bar without jumping off and still loose enough to be easily attached or removed.

Its advantages are as follows:

Extra and special characters are on hand at all times for use.

Considerable, in fact one-half of the time required in making double lines, on a typewriter can be saved, as follows:

The corporation for whom I am employed uses typewriters to make up a great many daily, as also monthly, financial, cost and statistical reports, and these statements, etc., make use of a great number of single and double ruled lines drawn on a typewriter. In making double lines, it is necessary to draw one single line clean across the page, turn the paper slightly forward, and draw another single line under the first.

I constructed a number of attachments as per the above for use on Underwood typewriters out of spring bronze, with lead printing surfaces, on which were cut out the character. When one of these was slipt over the type for instance, one not used but very seldom, say fractions, etc., and the key pressed, the result was a double line with the same time it would have taken to draw a single line, or one-half the time previously consumed in drawing double lines by the old method. This was readily proven a great time-saver.

I should like very much to learn your views on the above thru the columns of your excellent paper, which we all realize is foremost in the scientific and electrical world, and I trust you will give this early publication.

A. The idea certainly is new, and we think a patent can be obtained upon it. Without knowing how the shell is attached over the typewriter letters, it is impossible for us to tell whether the idea is practical. Off hand, without having seen a model, we are inclined to believe that such shells would work themselves loose and would not give writing strictly in alignment, but perhaps our correspondent has overcome this. If the shells can be made so that they do not come loose and the writing stays in alignment, we think a valuable patent can be obtained upon such a device.

Generator.

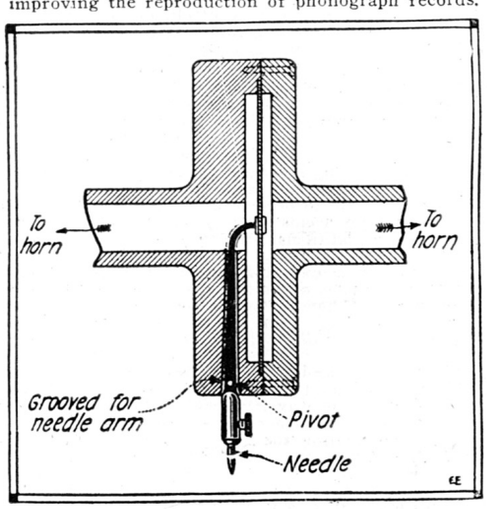
(371) Martyn Cooney, San Francisco, Calif., states: I would like your opinion on an idea of mine. A generator produces electricity by the armature rotating inside the field magnets and I have also heard of the field rotating while the armature was stationary. My idea is to have the armature rotate in one direction and the field magnets rotate in an opposite direction, thus producing more current and also enable the machine to run at slower speeds. In the case of a large alternator it would have a number of field magnets all rotating in opposite directions.

A. This is not a new idea, having been tried by many investigators. The trouble with such a device is that it is much too complicated for commercial work, and nothing is gained in power.

Phonograph Reproducer.

(372) Paul B. Kingsley writes us:

Would like your advice concerning a method for improving the reproduction of phonograph records.



On all phonographs I have had the privilege of examining, the sound from only one side of the reproducer diafram is amplified. In all musical instruments which have a vibrating element, such as a string or reed, the sound from the moving element is used completely.

The reproducer I have in mind, as you will see by examining the diagram, utilizes the sound from both sides of the diagram which, to my mind, will give a greater clarity of tone, more nearly recreating the original source of sound. And it certainly would give a greater volume of sound with smaller means of amplification. While this deduction is wholly theoretical, since I have no model, I can recall no acoustical law which would seem to contradict my prediction. I am not sure of the real value of his idea nor of the originality.

U.S. PATENTS

SEND FOR THIS FORM

Don't Lose Your Rights

Before disclosing your invention to anyone send for blank form "Evidence of Conception" to be signed and witnessed. A sample form together with printed instructions will show you just how to work up your evidence and establish your rights before filing application for patent. As registered patent attorneys we represent hundreds of inventors all over the U. S. and Canada in the advancement of inventions. Our schedule of fees will be found reasonable. The form "Evidence of Conception" sample, instructions relating to obtaining of patent and schedule of fees sent upon request. Ask for them,—a post card will do.

LANCASTER & ALLWINE

255 OURAY BLDG.,
WASHINGTON, D. C.
"Originators of form Evidence of Conception"

PATENTS

TO THE MAN WITH AN IDEA

I offer a comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience and familiarity with various arts frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN, Patent Lawyer
164 Owen Building, Washington, D. C.
2276-8 Woolworth Bldg., New York City

PATENTS TRADE-MARKS AND COPYRIGHTS

Before disclosing an invention, the inventor should write for our blank form "EVIDENCE ON CONCEPTION." This should be signed and witnessed and if returned to us together with model or sketch and description of the invention we will give our opinion as to its patentable nature. Electrical cases a specialty.

Our illustrated Guide Book, "HOW TO OBTAIN A PATENT," sent Free on request. Highest References Prompt Attention Reasonable Terms

FREE COUPON **VICTOR J. EVANS & CO., Patent Attorneys**

Chicago Offices: 1114 Tacoma Bldg. Pittsburgh Offices: 514 Empire Bldg. Philadelphia Offices: 135 S. Broad St. New York Offices: 1001-1007 Woolworth Bldg.
MAIN OFFICES: 779 NINTH, WASHINGTON, D. C.

Name..... Address.....

CAN YOU

think of a simple, practical idea that will fill one of the many requests we have on file for new inventions? It may mean a fortune for you. Thousands of things are needed RIGHT NOW. YOUR brains can help. Send today for our great new book—"Inventions and Trade Marks, Their Protection and Exploitation" and learn more about making money from ideas than you ever knew before. It tells many things that are wanted, too. A postal will do—it is free.

We help our clients, without charge, to get the dollars out of their ideas—having facilities none others possess.

Advice free.

Don't delay—get the book at once.

AMERICAN INDUSTRIES, INC.

225 Patent Dept., WASHINGTON, D. C.

PATENTS ADVERTISED For SALE FREE In INVENTION And MANUFACTURING SUPPLEMENT.

Published for the man with an idea. Send for free sample copy. One year's subscription 50c.

? HOW TO MAKE

MONEY WITH YOUR PATENT
HOW TO SELL
HOW TO KEEP CONTROL
HOW TO ORGANIZE
HOW TO RAISE MONEY

These and hundreds of other vital questions the inventor must know to make his invention a financial success, fully answered in

The Inventors' Manual of Valuable Information

$1.00 per copy, postpaid

If you have a patent or are thinking of taking out one, protect yourself by getting all the information this valuable book contains.

Write for free circular and table of contents.

G. E. Perry Company, Publishers, 1324 Broadway N. Y.

Free Book on PATENTS

Write today for a Free Copy of "How to Obtain a Patent." Contains valuable information and advice to inventors. Tells how to secure Patents. Send model or sketch of your invention for opinion of its patentable nature—Free. (20 years experience.) Talbert & Talbert, 4782 Talbert Bldg., Washington, D. C.

How to obtain a Patent

INVENTORS HAVEN'T YOU SOME IDEA that you can't just work out?

Give us the idea—we will develop it for you. Mechanical and electrical ideas developed. Experts in model and experimental work and in perfecting inventions. Designing and building labor-saving machinery a specialty. Get in touch with us—we can save you money.

ELK MFG. CO., INC.
1926 Broadway, New York

Patents Promptly Procured

Send sketch or model for actual search of U. S. Patents. Highest references. Personal service. Moderate fees. Write for Free Patent Book.

GEORGE P. KIMMEL, Patent Lawyer
99-C Loan & Trust Bldg. Washington, D. C.

PATENTS

Send sketch or model for preliminary examination. Booklet free. Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 624 F St., Washington, D. C.

A. We have carefully looked over your contrivance, and would say we do not think much will be gained by having the sound come out from two sides of the diafram. Our reasoning is based on the following:

If only one side is used, the small chamber that is created between the closed side of the diafram and the wall of the reproducer acts as an amplifier on the diafram, and thus strong impulses are set up in the diafram itself. As soon as you perforate this wall, the action must be reduced and the diafram will not vibrate as powerfully as before.

In the 80's, some telephone receivers were constructed on exactly the same plan as for instance Mr. Ader's of Paris, who constructed several types with two horns. Any standard book on telephone types will reveal this. The advantages, however, were not sufficient to go to the added expenses of these telephones which are not in use now.

Chair Device.

(373) Mr. Robert N. Rose, of Whittier Street, Queens, L. I., writes:

I would like to ask thru your "Patent Advice" if you think a patent could be obtained on the following idea:

Perhaps you have often noticed that the rungs of chair are often scratched and the paint rubbed off by placing our feet on them. So I have devised a protection for them. I use a steel rod, which may be cut to any size, and at each end is fitted a spring clip, the rod being one-quarter inch thick and the clips are soldered to the rod.

This is very easily made and can be retailed at about three cents apiece.

A. We should say that while this device seems to have merits, we do not think there is sufficient demand for it, and we doubt that a patent can be obtained.

Stereoscopic Movies.

(374) Mr. Horace S. Cottrell, of Napier, N. Z., writes us the following interesting letter:

An article on Stereoscopic Movies in a recent number of your journal has had my attention. 'Way back in 1911 I evolved an idea for producing stereoscopic effects on the screen. I believe it will work, but then I have no facilities for trying it out.

Since the time the idea came to me, now over eight years ago, I have kept an eye open both in the movie magazines and on the screen for the "stereo" movie to become a reality. The basic idea of my scheme seems to me so obvious that I cannot but think that it is sure to have been tried out before. The somewhat impractical scheme outlined in your paper, except from an experimental point of view perhaps, is the first discussion on the stereo movie that I have seen for some years. Anyway, here's my idea: *That the two pictures of stereoscopic vision shall be photographed alternately on the Kine film.*

The optical and mechanical means of producing this result should present few difficulties. I have my ideas of the way it might be done, but that is of secondary importance at the present stage.

In expounding the scheme, I would point out that the stereoscopic effect can be and is secured on the screen for the un-aided eye under certain circumstances. You will see it on train rides and scenes taken from a moving boat where the camera is moving, the picture and the next one just a little farther on, letting you see with the other eye, so to speak.

I have also seen stereo effects in some Pathé fashion and flower studies. In these, the camera was stationary and the figure and flower revolving slowly.

A. There seems to be no objection to the fundamental idea of our correspondent, but we are very much in doubt as to whether the film would work as described, in actual practise. The action of which our correspondent speaks is nothing but a freak action and does not always occur. It depends a great deal upon the speed of the film as well as on the subject. We do not think, therefore, that all the subjects would lend themselves for stereoscopic production as mentioned.

EXPECTED ELECTRIC SHOCK IS RARELY FATAL.

Dr. S. Jellinek, analyzing the effects of severe electric shocks received by contact with electrified wire fences during the war, writes in *Elektrotechnik und Maschinenbau* that an important factor was the state of preparedness of the victim. Experience has shown that a shock which was likely to prove fatal if received unexpectedly was harmless when anticipated. Experiments on animals have confirmed this impression and have been instrumental in showing that physiological effects of shocks administered with direct and indirect current are distinctly different.

It is also remarked that a close resemblance to death after shock should not be accepted too readily as proof. Persons apparently dead have not infrequently recovered when artificial respiration was applied. It is best to give the victim the benefit of the doubt.

PATENTS

If you have an invention and desire to secure a patent, send for our Free Guide Book, HOW TO GET YOUR PATENT. Tells our Terms, Methods, etc. Send model or sketch and description for our opinion of its patentable nature.

RANDOLPH & CO.
Dept. 172 Washington, D. C.

PATENTS

Record your invention, before filing application, by using my form "Fixing the Essential Dates of Invention," sent upon request with full information. Prompt personal services by an attorney-at-law having over twelve years actual experience Reasonable pre-war charges. B. P. Fishburne, 324 McGill Bldg., Washington, D. C.

PATENTS

Hand Books on Patents, Trade Marks, etc., sent free. Our 70 years of experience, efficient service, and fair dealing, assure fullest value and protection to the applicant. The Scientific American should be read by all inventors.

MUNN & CO., 622 Woolworth Bldg., N. Y.
Tower Bldg, Chicago, Ill. 622 F St, Washington, D.C.
Hobart Bldg., 582 Market St., San Francisco, Cal.

PATENTS

C. L. PARKER
Formerly Member Examining Corps. U. S. Patent Office.
PATENT LAWYER
McGill Bldg.
Washington, D. C.

Patents, Trade Marks, Copyrights, Patent Litigation

Handbook for Inventors, "Protecting, Exploiting and Selling Inventions," sent upon request.

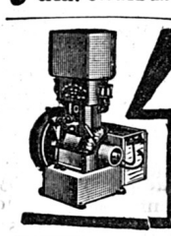
We can sell

YOUR PATENT

Quick, positive results. Write us for details.

IMPROVED SALES SYSTEM
153 West Sixty-ninth St., Chicago, Ill.

Swing 4 in., 11 in. between centers, 17 in. total length. Shipping weight 13 lbs. Bed of lathe is machined. Workmanship first-class. Equipped with wood turning chuck. Can be fitted with 3 in. face plate and drill chuck as special equipment. Order one today. Price $5.00 cash with order. SYPHER MFG. CO., DEPT. C. TOLEDO, OHIO



SMALL ENGINES

Perfected Gasoline Engines—½, 1 and 1½ h. p.—for Farm and Shop use. Price, $27.50 and up. Also,
WASHING MACHINES
We ship on trial. Send for Booklet and Special Offer.
SIEVERKROPP ENGINE CO.
1401—19th St., Racine, Wis.
STARTER for FORD CARS

UMAKEM

Airplane Workchest, containing aircraft work table with mitre cutting board and length gauge, steel drill, steel hammer, Model Maker's steel square, screwdriver, sandpaper block, 10" scroll saw, together with finest quality reed and bass wood, aluminum, silk, para rubber, full set of blueprints, directions, and all fittings for building one 36" Bleriot Model flying Monoplane. Price $10.00. Other UmakeM Outfits 50c to $50.

W. R. PRICE, Inc.
No. 2 UmakeM Building, 127 Fifth Avenue, New York

Dr. B. LUST'S RECREATION RESORT

"YUNGBORN" BUTLER, N. J. IN THE RAMAPO MOUNTAINS

Natural Life and Rational Cure Health Home for Dietetic-Physical-Atmospheric Regeneration Treatment. Fount of Youth, and New Life School for those in need of Cure and Rest, for the physically and spiritually weakened, for those overworked and for the convalescent.

OPEN ALL THE YEAR
Winter Branch: Florida Yungborn, Tangerine, Florida

STAMPS 50 all diff. British Guiana, Cuba, China, India, Jamaica, Japan, Portugal, Venezuela, etc., only 10c; 100 all diff. 20c; 1,000 all diff., fine collection in itself, $5.00; 100 diff. U. S. 50c; 1,000 hinges 10c. Agents wanted, 50% commission. List Free. I BUY STAMPS.
L. B. DOVER OVERLAND, MO.

The Golden Vapor

By E. H. JOHNSON

(*Continued from page* 1066)

apparatus already filling a large portion of the room. Devices for producing ultra-violet light in powerful beams were added, and mercury vapor lamps replaced the ordinary electric lamps in the ceiling. This was because he had always found his experiments to succeed best in the presence of these radiations of short wave-length.

Such was his success that he was soon able to transfer some of the heavier gases from one bulb to another, just as he had first done with the helium. Then came metallic vapors, the lighter ones first, and finally that of mercury,—all of course, initially inclosed in a sealed bulb free from the presence of other substances and made to reappear in the *Medior*. But the latter, for the reasons which had led him to so name it, was never intended to be the final receiver; it was to be but the *medium*, the agency to affect the transformation of what it received from an ether wave energy form to that of a particular electric current. This, in turn, was to be further transformed into its characteristic matter form by the *Materializer*. However, the difficulties involved when this step was attempted under any but ideal conditions, had made the *Materializer* hitherto of little more than theoretical usefulness. And then in a brief moment he had found that the interposition of suitable condensers between the two bulbs solved the problem completely. When in operation the faintly luminous rays in the *Materializer* brought the tiny metallic bead to a bright incandescence, and a vapor soon appeared around it, condensing and forming on the sides of the bulb as an impalpable powder or sometimes as a liquid, which could be drawn off by means of the stop-cock below.

The principal steps in the process were as follows: A bulb containing, say mercury vapor, was set in the path of a beam of ultra-violet light which in turn also past to the Medior, tho the latter was possibly some feet away. (Absorption of these radiations by the air and other media had been obviated by giving the waves themselves a suitable form.) The grid in the *Medior* was then heated by an auxiliary electric current from a small storage battery, and the entire bulb was oriented so that its concave mirror faced the beam of ultra-violet rays. Then the high-frequency, high-potential apparatus was started and as soon as the condensers were adjusted to the proper capacities, the tiny sphere at the focus of the mirrors of the *Materializer* would begin to glow,—a bluish vapor would surround it and soon minute globules of metallic mercury would begin to roll down the sides of the bulb and could be drawn into a beaker below.

However, some limitations still remained that he saw must be removed before his great dream could be entirely realized. Among them was the fact that the substance to be transferred by this method must begin its transformation in a hermetically sealed flask, entirely freed from the presence of even the slightest trace of any other substance. Then again, he had been able to make the transfer only when the active beam of ultra-violet rays was approximately at right angles to the direction of the earth's gravitational force. On this latter subject he had thought almost constantly, and had even written a lengthy paper—"*On the Relation of Electronic Path to the Direction of the Gravitational Vector*"—with the notion of reading it at the approaching meeting of the *American Physical Society* in San Francisco. But

To cut down the cost per cut

Put on the Weight

If you're cutting with a medium or heavy power machine, start out with a good, full, 45-pound pressure after the first two or three strokes. As the number of cuts progresses, increase your weight. Remember that once the first keenness of the blade is gone, the heavier gauge of the blade the greater the pressure required to make the teeth "bite." Too little weight will ruin a blade almost as quickly as too much.

Follow the Starrett Hack Saw Chart in selecting your blades. Put on the weight and watch the cost per cut go down.

THE L. S. STARRETT CO.
The World's Greatest Toolmakers
Manufacturers of Hack Saws Unexcelled
ATHOL, MASS.

Use Starrett Hack Saw Blades

42-974

Earn $100 a day repairing and retreading tires

Business good and fast growing. Wonderful opportunity to get into a most profitable business. Hundreds of cars. Hundreds of customers. Our Free Tire REPAIRING MANUAL gives full particulars and shows how to do the most satisfactory work. Write today. Why slave your life away for others when your own name can go across the door and you be the proprietor and have others work for you. Vanderpool makes you successful and independent for life. Write today.

WM. VANDERPOOL COMPANY, Springfield, Ohio
In answering address Dept. U-20.

DO YOU KNOW

That at 8° above zero your battery is only 50% efficient. This means that you must keep your starting battery fully charged at home with the

F-F BATTERY BOOSTER

The new size 6 Ampere $15.00 F-F Bantam Battery Booster charges a 6 Volt battery efficiently from 110 Volt 60 Cycle A. C. current. Attaches to any lamp socket and costs no more for current than burning a lamp. Battery is left right in car without disconnecting and charged over night unattended. New 5 Ampere 12 Volt Bantam at $20.00.

Send check for express shipment. For parcel post add postage and insurance to cover shipping weight of 15 pounds. Ask for bulletin 12 describing this and other F-F charging apparatus of larger capacities including those operating on farm lighting plants and direct currents.

Write for Bulletin No. 12

THE FRANCE MANUFACTURING CO., Cleveland, Ohio

$15 AND UP

ELECTRICITY

Taught By A Practical Man

LEARN

Practical electricity by the Burgess Method of using your spare time

AT HOME

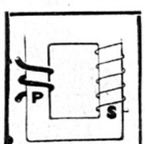
Hundreds of Burgess-trained men and boys have advanced to better positions by means of the practical electrical knowledge easily learned at home by this method. If you are willing to utilize a little of your spare time you can do the same.

For Beginners and Experienced Men

This home study course is based upon the years of practical electrical experience of Yorke Burgess who gives personal attention to each student.
There is no limit to what you can accomplish with its aid. It is up to you.

Results of Burgess Service

Practical electrical men recommend this course to others. Students are invariably promoted and get better salaries. Over 80 per cent. of the students are engaged in the electrical business. Over 15 per cent. of present enrollment came through satisfied students. Beginners get employment in electrical work after taking the course a short while.



The Burgess Service is so universally successful, that we give positive assurance of perfect satisfaction on completing the course or money refunded. There are no strings tied to this—you are the judge.

FIFTY-FIFTY

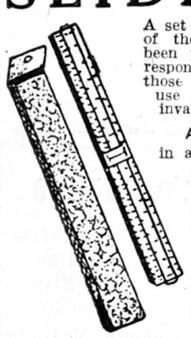
This method of learning PRACTICAL ELECTRICITY is supplied on EASY PAYMENTS, including apparatus, instruments, material, etc. Start any time—stop any time—your payments cease if you are not satisfied. Send for the BURGESS CATALOG today. Gives full information without cost or obligation.

Yorke Burgess, Supt.

BURGESS ELECTRICAL SCHOOL
745 East 42nd Street Chicago, Illinois

Practical Instructions on the

ELECTRICAL SLIDE RULE



A set of concise lessons on the use of the Electrical Slide Rule has been prepared by Mr. Burgess in response to many requests from those who desire to take up the use of this instrument which is invaluable to many electrical men.

A High Grade Slide Rule

in a leather case and the COMPLETE COURSE OF INSTRUCTION will be supplied at a VERY REASONABLE COMBINATION PRICE.

Write for full information.

BURGESS ELECTRICAL SCHOOL
745 E. 42d St., Chicago, Ill.

BURGESS BLUE BOOK

FOR STUDENTS and ELECTRICAL MEN

A pocket hand-book for ELECTRICAL MEN and STUDENTS. Contains over 200 CALCULATION FORMULAS and worked out problems showing their use. Also DRAWINGS of ELECTRICAL APPARATUS and DEVICES of which the inside connections are clearly shown. ALTERNATING CURRENT CALCULATIONS and dozens of everyday problems are covered. Recommended by electrical men all over the country. Used in technical schools. Purchased by electrical concerns for employees and customers. There is no other book like it.
A $1.00 bill, check or money order brings the book. We refund your money, if you are not fully satisfied.

Price $1.00

Yorke Burgess, President
BURGESS ENGINEERING CO.
Consulting Electrical Engineering,
750 East Forty-Second Street, Chicago, Ill.

the first thought of his earlier treatment at the hands of those other scientific societies in Europe caused him to tear it up and burn the strips slowly over a Bunsen burner, smiling as he watched the glow of the ink on the falling flakes of ash, as if the joke were on others and not on himself.

The work of Mosely, the Braggs and others opened up a new avenue for attacking the problem which now excluded all other thoughts. It had been found that the X-rays excite secondary X-rays by the molecular agitations of the substances thru which they pass, and that these new rays possess characteristics relating them to the emitting substances. Their directions were also different from those of the primary rays which had excited them, so that they seemed at first to be only the same radiations after reflection.

Beginning with these facts Grieg was soon able to reverse the action of his *Materializer* and *Medior* so that a vapor or finely divided solid which had been inserted into the former might be de-materialized and transmitted to a distant place, and there re-materialized by the same sort of apparatus used as a receiver.

Then came another great discovery. If the flask which was to act as the receiver, already contained a substance in a similar form (that is, solid or vapor) to the substance in the transmitting bulb, but of greater molecular weight, the mere impinging of the charged violet rays on this substance set up molecular agitations resulting not only in the automatic materialization of the substance sought, but also in the emission of secondary rays in exactly the opposite direction, and these in turn bore back in pure energy form, portions of the denser material. Thus a single transmitter became both a *de-materializer* and a *materializer, a sender and a receiver!*

The experiment was tried out repeatedly. For example, equal masses of tin and lead had thus been exchanged, and the only characteristic difference in the appearance of the sending bulb was that when acting at the same time as a receiver, its vapors were in violent tumult. This motion ceased only when one or both of the substances had been completely transferred. Still further refinements had then enabled Grieg to make the exchange in any direction and thus the gravitational factor which had long been a stumbling block was eliminated.

Following this last success and for the first time in months, he seemed to move leisurely. Deliberately he would wander about his room with the air of one who knows that his plans have not miscarried, and who sees their final triumph easily within his reach. The battle was won; he had but to accept the victory! The fact that he was meditating on what society would call a grave crime, scarcely entered his mind. When it did he only smiled cynically, as always, in the consciousness of his own security. Tho he should not be clast as a moral pervert, or one naturally bad, he was perhaps now little better, for he had lost all of his former feeling of moral and social responsibility. Human laws and customs mattered to him not at all. The experiment should be tried, come what might. It would in itself be his life's triumph, his triumph over his old critics, the supreme proof of the fallacy of human notions of security. And of the more material reward which would accompany it, well, that was secondary; but after all it would be pleasant to rest, and in what way more enjoyably than to wander leisurely up and down the length and breadth of his native Alsace-Lorraine and visit again the scenes of his student days—when the means were available?

* * * * *

FREE

$20

TENOR BANJO Ukulele, Hawaiian Guitar, Violin, Mandolin, Guitar, Cornet or Banjo

Wonderful new system of teaching note music by mail. To first pupils in each locality, we give a $20 superb Violin, Mandolin, Ukulele, Guitar, Hawaiin Guitar, Cornet, Tenor Banjo or Banjo absolutely free. Very small charge for lessons only. We guarantee success or no charge. Complete outfit free. Write now. No obligation.
SLINGERLAND SCHOOL OF MUSIC, Inc. Dept. 41 CHICAGO, ILL.

Send To-day for the

"Electrical Worker's Friend"

An electrical book of 66 motor drawings with complete instructions for rewinding and reconnecting A.C. motors. Special at **$4.00**
Or write for full particulars of this valuable book

SMITH & SMITH PUBLISHING CO.
Dept. B. 1524 Lowrie St., N. S., Pittsburgh, Pa.

Handwriting Tells You Secrets

Be successful. Find out what holds you back. Send us an ink specimen of your handwriting and $1.00. Our expert Graphologists will tell you your faults, virtues, talents, etc. Your $1.00 back if you are not satisfied.

ROBERT R. ROSS, 110 West 40th St., N. Y.

"Lighting Fixtures"

Ready to Hang
(Direct from Manufacturers)
Completely wired, including glassware. New designs.
Send for catalogue No. 18

ERIE FIXTURE SUPPLY CO.
Sta. C Erie, Pa.

Music Lessons UNDER MASTER TEACHERS **At Home**

Complete Conservatory Course by Mail

Wonderful home study music lessons under great American and European teachers. Endorsed by Paderewski. Master teachers guide and coach you. Lessons a marvel of simplicity and completeness.

Any Instrument Write naming course you are interested in: Piano, Harmony, Voice, Public School Music, Violin, Cornet, Mandolin, Guitar, Banjo or Reed Organ —and we will send FREE CATALOG. SEND for it NOW!

University Extension Conservatory, 6237 Siegel-Myers Bldg., Chicago

I TEACH Penmanship BY MAIL

I won World's First Prize for best course in Penmanship. Under my guidance you can become an expert penman. Am placing many of my students as instructors in commercial colleges at high salaries. If you wish to become a better penman, write me. I will send you FREE one of my Favorite Pens and a copy of the Ransomerian Journal. Write today.

C. W. Ransom, 511 Essex Bldg., Kansas City, Mo.

DEAFNESS IS MISERY

I know because I was Deaf and had Head Noises for over 30 years. My invisible Antiseptic Ear Drums restored my hearing and stopped Head Noises, and will do it for you. They are Tiny Megaphones. Cannot be seen when worn. Effective when Deafness is caused by Catarrh or by Perforated, Partially or Wholly Destroyed Natural Drums. Easy to put in, easy to take out. Are "Unseen Comforts." Inexpensive. Write for Booklet and my sworn statement of how I recovered my hearing.

A. O. LEONARD
Suite 369, 70 5th Avenue -- New York City

Fun, Magic and Mystery!

56 Feats in Magic, 250 New Jokes, 21 Puzzles, 1 Fortune Telling Tablet, 52 Money-Making Secrets, 15 Card Tricks, 71 Toasts, 58 Verses in Comic Poetry, 10 Funny Readings, 41 Epitaphs, and 11 Parlor Pastimes. You get all the above-mentioned and our big illustrated Catalog of 125 Magic Tricks for only 10 cents. Write today.

DETROIT TRICK & NOVELTY CO.
454-456 Dix Avenue Detroit, Mich.

BE AN EXPERT Penman

Wonderful, new device, guides your hand; corrects your writing in few days. Big improvement in three hours. No failures. Complete outline FREE. Write C. J. Ozment, Dept. 44, St. Louis, Mo.

BE A BANKER

Prepare by mail in spare time for this attractive profession in which there are great opportunities for both men and women. Send at once for free book, "How to Become a Banker," by EDGAR G. ALCORN, President.
American School of Banking, 114 McLene Bldg., Columbus, O.

Thus it was that the days went by. The first day of November had arrived and nearly past. Grieg, who had just eaten a good meal at a nearby restaurant, was now strolling aimlessly along the streets and thinking for the most part of mere trivialities, but never for one moment losing sight of the fact that to-night he was to carry out an experiment more wonderful than any dreamed of by the alchemists. To-night should witness an enterprise that would at once distance all other human endeavors and baffle the keenest of sleuths.

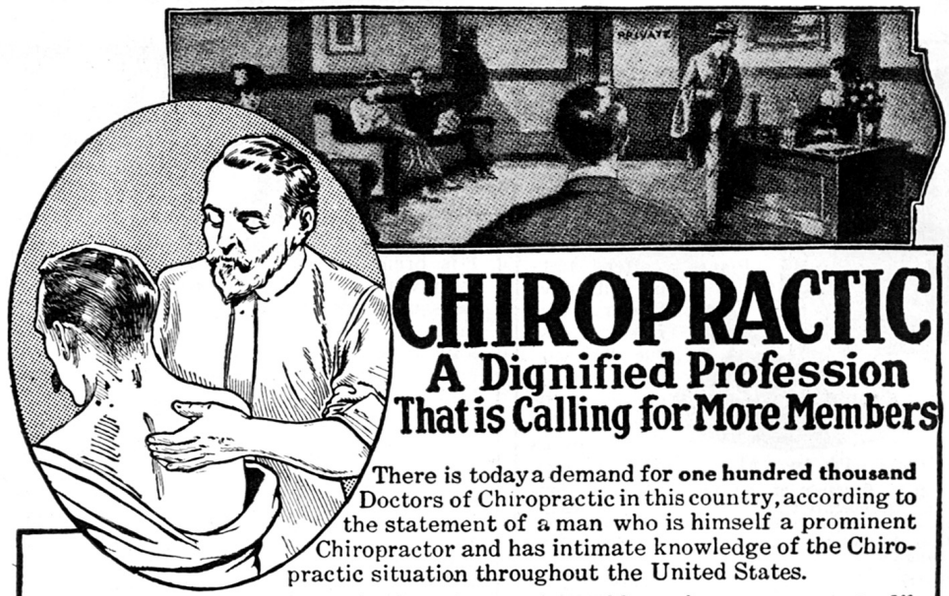
As a distant clock chimed the hour of nine, he turned back to his room. At once his step took on the alertness of one who has made a decision. There was work to be done and done now. Once more he was the keen scientific investigator. Every sensibility was alert, and the training of a lifetime showed itself in every movement.

On entering his room he switched on a small, blue light, glanced around and at once seated himself before the apparatus on the huge table in the center. The pump had been running uninterruptedly for days and the gage showed that every joint was tight. A tiny pilot light here and there told that all wires were intact and ready for their task. In place of the single *Materializer* bulb that had been seen previously, there was now a row of such bulbs, six of them, each larger than the original one, and they were all connected to the pump and so arranged that each could be switched into circuit instantaneously. Above them was a large glass funnel or hopper filled with a bluish-gray metallic appearing powder. From this ran a large tube which in turn branched out so as to enter the top of each of the *Materializer* bulbs, and admit the powder to any one of them on opening the proper stopcock. Beneath each of these bulbs was the usual large beaker. No receiver was visible. It had ceased to be necessary soon after Grieg had succeeded in using the secondary radiations as a returning agency. Evidently the experiment was to take some form not hitherto seen.

With a last glance over the apparatus, he slowly closed the master switch which made the whole assembly of mechanism become a thing of potentialities. Then one by one, smaller switches were also closed, until from the slight hum and glow of the various contrivances one would judge that all was in working order, set for the attack, whatever it might be.

Slowly Grieg turned the great *Medior* bulb first one way and then another and finally he clamped it pointing directly downwards. After opening one of the inlet cocks so as to let a little of the gray powder filter down into the first *Materializer*, he watched it intently for a long time. The focus glowed and then the usual vapors appeared, velvety and blue and hovering quiescent like a spirit soon to vanish. Then he examined the luminous region with a spectroscope, but soon he set it aside, shook his head in a worried manner, and directed his attention once more to the powerful *Medior*. Apparently some adjustment was incomplete. Beginning as before, he swung the great globe one way and another as one might guide a searchlight in exploring a distant hillside. Always he kept it *pointing in a general downward direction,* while the *Medior* rays played upon some iron bars, and always he watched the glowing haze in the *Materializer*. From time to time it seemed to show slight tremors, but nothing of the violent nature he was seeking. Then he swung it thru a wider angle, sweeping out larger and larger circles with its axis, and all the while watching intently the tell-tale glow at his side.

Suddenly he stopt. For a moment he seemed as one stupefied. The iron bars on



CHIROPRACTIC
A Dignified Profession That is Calling for More Members

There is today a demand for **one hundred thousand** Doctors of Chiropractic in this country, according to the statement of a man who is himself a prominent Chiropractor and has intimate knowledge of the Chiropractic situation throughout the United States.

Even if this demand remained stationary, it would require many years to fill it. But the demand is constantly increasing because more and more intelligent people—those who do their own thinking—are becoming convinced that Chiropractic (the advanced Science of Spinal adjustment) is the common sense and really scientific way to relieve pain and disease.

A Real Opportunity

Do you realize what this means to you if you are really ambitious? It means that never has there been a more opportune time for you to align yourself with the members of a great profession that is forging rapidly to the front. Today Chiropractic is receiving the serious consideration and hearty endorsement of even many doctors of the old schools of medicine, of clergymen and of large numbers of scientific thinkers and investigators. And Chiropractic is a profession of rich financial rewards.

$3000 to $5000 a Year

Many Doctors of Chiropractic earn that much and more. Some upwards of $10,000. Dr. M. D. Moore, of Kentucky, reports an income of $9,000 a year. Dr. L. H. Roche, New Jersey, $5,000. Dr. Hanna, of Florida, over $5,000 yearly.

The success of Chiropractors, in many cases, has come so quickly as to be almost startling. And yet, it is not to be wondered at when you consider the scientific accuracy of Chiropractic methods and the comparatively few Chiropractors that are now in the field.

Become a Doctor of Chiropractic
In Spare Time AT HOME

The American University method enables you to study by mail or in class and obtain a complete mastery of Chiropractic in the shortest time consistent with thoroughness, while you hold your present position. Easy terms. A splendid faculty will personally instruct you in the basic principles and in the most approved methods of relieving Headache, Indigestion, Lumbago, Epilepsy, Pleurisy, Constipation, Rheumatism, Asthma, Neuralgia, Neuritis, Catarrh, Fevers, Jaundice, Dyspepsia, Paralysis, etc. No special preliminary study is needed. You graduate with the degree of Doctor of Chiropractic and are ready at once to open your office.

22 Charts Free!
Send Coupon

We have prepared 22 remarkable Anatomical and Pain Area and other Charts—a total value of $31.50. Our special offer places all of these 22 Charts FREE in the hands of ambitious men and women. We will send all particulars and our 72-page book free on request.

We know what the opportunities are and we see no reason why you should not "cash in" on these opportunities just as fully as others have done and are doing. A postal or the coupon will bring complete information about course, easy payment plan and the Free Charts offer.

AMERICAN UNIVERSITY
Manierre Bldg., Dept. 683 Chicago

Gentlemen:—Without cost or obligation, send me by mail, your new illustrated, 72-page book and details of your easy payment plan and Free Charts offer.

Name .....

Address .....

City ..... State .....

"The Eastern" is a Large Achromatic Telescope

MADE UPON NEW SCIENTIFIC PRINCIPLES.

Positively such a good Telescope was never sold for this price before. **Eastern Telescopes** are made by one of the largest manufacturers of telescopes in America; we control entire production; measure closed 9 inchss and open over 3 feet in 4 sections. They are nicely brass bound, with scientifically ground lenses. **Guaranteed by the maker.** Every sojourner in the country or at the seaside resorts should certainly secure one of these instruments, and no farmer should be without one. The scenery just now is beautiful, a Telescope will aid you in taking views. Objects are brought to view with astonishing clearness. Sent by mail or express, safely packed, prepaid, for only **99 cents.** Our new Catalogue of Watches, etc., sent with each order. This is a grand offer and you should not miss it. **We warrant** each telescope just as represented or money refunded. Send **99 cents** by Registered Letter, Post Office Money Order, Express Money Order, or Bank Draft payable to our order, or your newsdealer or store-keeper will order one for you. Whether consumer or dealer, send cash with order. **To dealers 6 for Four Dollars.**

EASTERN NOVELTY CO., 67: 172 E. 93d STREET, NEW YORK.

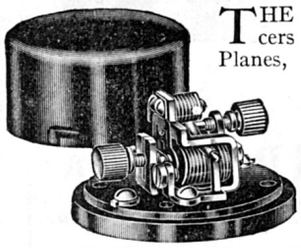
Stop! Don't flirt with death. Use Mystic Cloth—a rub a day keeps danger away. Absolutely smearless.

AGENTS—Make $60 Every Week

selling new invention for autos, street cars, locomotives. **Wonderful Mystic Windshield Cloth.** Works like magic. One rub over rain or snow-blurred windshield, presto! **glass stays clear 24 hours.** Can't blur. Prevents accidents, saves time, money, worry. Greatest safety first accessory ever invented—fastest seller—30,000 first month. Every car owner, motorman, engineer, buys on sight. Endorsed by railroads. Guaranteed one year. Agents amazed—getting rich. Listen! Trippe made $117 in 3 days—Early $128 first week—Chase sold 5000—Vanpelt writes: "A deaf, dumb and blind man could sell it." Hundreds like these. You can do as well. Failure impossible. EXPERIENCE UNNECESSARY. Sells itself—you take orders—that's all. Big selling season now on. Investigate. Exclusive territory, details—worth fortune—ALL FREE. **SECURITY MFG. CO., DEPT. 250. TOLEDO, OHIO.**

Mesco Radio Buzzer

With Shunt Resistance —
U. S. Navy and U. S. Army Standard



THE Radio Officers of the NC Planes, after testing all other buzzers, decided to use the "Mesco" on their radio equipment. The R-34 was equipped with two Mesco Radio Buzzers.

Why? Because of its reliability and constancy in operation; greater output efficiency; ease of adjustment; unaffected by extreme variations in weather conditions; exposed wires eliminated.

Sparking is almost entirely eliminated, so that the energy lost in light and heat in the operation of other buzzers is here conserved and radiated in the form of oscillating energy.

This buzzer maintains a constant note and is recommended as an exciter for checking wavemeters where pure note and ample energy are required.

List No. 55, Mesco Radio Buzzer
Price $2.05

MESCO WIRELESS PRACTICE SET

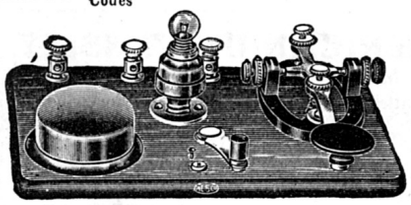
The Practice Set comprises a regular telegraph key without circuit breaker, a special high pitch buzzer, one cell Red Seal Dry Battery, and four feet of green silk covered flexible cord.

The key and buzzer are mounted on a highly finished wood base, and three nickel plated binding posts are so connected that the set may be used for five different purposes.

List No.		Price
342	Telegraph Practice Set, with Battery and cord	$3.24

Weighs 4 lbs. packed.
Price does not include postage.

MESCO **Combination Practice Set for Learning the Mo. and Continental Visual and Audible Codes**



This outfit is the only reliable instrument which will enable students to become proficient operators in the U. S. Naval Service, because it is equipped with a buzzer and miniature lamp enabling the user to master both the visual and audible signals quickly.

List No. 52—Practice Set with Red Seal Battery and Cord.....$4.05
Weighs 4 lbs. packed. Price does not include postage.

We carry in stock a Large and Complete Line of Standard Wireless Material. Experienced Wireless Experts in Charge to explain and demonstrate it.

W-10 Wireless (MESCO) Manual W-10
TRADE MARK.

About March 15th we will have ready for distribution a new Manual and Catalog of standard radio material illustrating and describing in detail the various instruments used in connection with the transmission and reception of wireless messages. No expense has been spared to make this Wireless Manual complete and up-to-date in every way so as to be of assistance not only to the amateur, but also to the professional user and experimenter in the most fascinating of all modern arts.

The size of the Manual will be 5¾" x 9" and will contain approximately 180 pages.

If interested send in your name and address and a copy will be sent to you as soon as issued.

Manhattan Electrical Supply Co., Inc.
17 Park Place, New York, N. Y.
CHICAGO 114 S. Wells St.
ST. LOUIS 1106 Pine St.
SAN FRANCISCO OFFICE: 604 Mission St.

which the downward rays were playing slowly seemed to "dematerialize," nay, vanish into the thin air! Then he leaped to the spectroscope, directed it toward the boiling vapors in the globe before him, and sat for a time as if hypnotized—held by some strange sight.

As soon as he moved slightly, it was apparent that his excitement was very high. His breathing came short and fast. And then with what seemed almost a shudder, he sank back in his chair, buried his face in his hands, and remained silent for a long time. When again he looked up, his eyes and hands were wet. New lines in his face told how great had been his recent emotion.

Like one who has climbed long and laboriously to reach some far height, and who sighs almost in disappointment when he realizes that no higher levels exist, Grieg sat and gazed blankly before him rapt by vistas reaching far beyond his laboratory walls. Pleasant lands spread out before him, thru which came many roads filled with all manner of travelers. They were bringing tribute to him. It was a golden view, rich in the warmth of a bluish golden light that filled the dome of the sky above and seemed to hover like a gilded cloud about his fair mountain. And from all around arose the hum of a teeming civilization—the droning tone of a busy world—the monotone of existence itself. But no, it was only the purr of his faithful little motor, and the buzzing and hissing of a myriad tiny sparks that had shaped his dream. And the glow was still confined to the fragile bulbs before him.

Shaking off his stupor, he turned once more to examine them. Slowly their vapors were condensing in a fine powder about the sides and bottom of the sphere. He opened the bottom stop-cock and caught a little of it on a watch glass, rubbed a bit of it between his fingers, and held it near a light. IT WAS DISTINCTLY YELLOW! And the clouds within his bulbs were still seething violently. . . .

It was on the fourth of December when next Grieg was seen—on that night when the crowds had been hurrying homeward and when the newsboys had been calling out their wares with such uncommon vigor. In the private office of the bank occupying the first floor of the building in which Grieg had worked so long, the directors and officers sat solemnly listening to a distinguished looking man, evidently their president. Excitement, worry and suspicion were written on the face of every one present, and it was all on account of a brief telegram that had been received that day from China. Tho it concerned a loss that would be considerable, still worse was the fact that its information had leaked out and might alarm the depositors. On the table about which these men were gathered lay a copy of the evening paper, scarcely an hour from the press, but by now widely scattered in all parts of the city. Under glaring headlines on the first page was the following:

GOLD SENT, IRON ARRIVES

Contents of $100,000 Box Mysteriously Change on Way to China.

SAN FRANCISCO, Dec. 4.—A box containing $100,000 in gold coin shipped by the Anglo and London-Paris National Bank of San Francisco on the liner Korea Maru was found to contain only iron when opened by the consignee in Hong Kong, according to advices received by the bank and steamship company today.

The box had been strongly guarded since it was first filled in the vaults of the San Francisco bank under the close inspection of several of the bank officials themselves. As the seals then applied were unbroken when it reached its destination, officials are at a loss to imagine how or where the exchange took place, and they frankly admit that so far they have found no clue that might lead to a solution of the mystery.

Says the Master Mechanic. The Greb Automatic Grip Puller is a One-Man Puller—Quick-acting, strong and simple in the extreme. May be locked in any desired position. A combination of two or three arms. Heavy Duty Size capacity 1" to 18"—Junior size capacity 1" to 7". Two sets of jaws furnished with each size.

Ten Days' Trial If your dealer or jobber does not have them we will send you one. Try it ten days. If not satisfactory, return to us and we will refund your money. We also make the GREB RIM TNOL.
THE GREB CO., 230 State Street, BOSTON

DENINGER WILL SAVE
BIG MONEY SAVINGS FOR YOU
$40
Used and rebuilt motorcycles, single and twins, $25 to $100. Used bicycles, $5.00; tandems, $10. All machines guaranteed in good working order. New bicycles and motorcycles at Factory prices. You save dealers' profits. Motorcycle and automobile tires too, $3.00. Complete line of parts and supplies.
Send for catalog Deninger Cycle Co., Rochester, N.Y.
YOU 25 TO 50 DOLLARS

The Seneca MOTOR CAR **Built for the Owner** $1085.00

Simple, Sturdy construction. Low cost of up-keep and operation. Cantilever springs in rear. Comfortable E-Z riding
4 cyl. - 27 H. P. 108 in. wheel base
Dealers Wanted Immediate deliveries. Fifth successful year. Increased output. Liberal newspaper advertising in dealers' territory. Wonderful opportunities. Write or Wire NOW.
THE SENECA MOTORCAR CO., 42 Seneca Factory, FOSTORIA, OHIO

COPY THIS SKETCH

And let me see what you can do with it. Many newspaper artists earning $30.00 to $125.00 or more per week were trained by my course of personal individual lessons by mail. PICTURE CHARTS make original drawing easy to learn. Send sketch of Uncle Sam with 6c in stamps for sample Picture Chart, list of successful students, examples of their work and evidence of what YOU can accomplish.
Please state your age
The Landon School of Cartooning and Illustrating
1510 Schofield Bldg., Cleveland, Ohio

POPULARITY FOLLOWS THE UKULELE

If you play quaint, dreamy Hawaiian music or latest songs on the Ukulele you will be wanted everywhere. We teach by mail 20 simple lessons; give you free a genuine Hawaiian Ukulele, music, everything—no extras. Ask us to send the story of Hawaiian music. You will love it. No obligation—absolutely free.

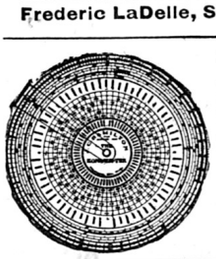
The Hawaiian Institute of Music
1400 Broadway, Dept. 5B New York

Learn the Sign-Show Card Business

Big field—unlimited possibilities—increasing demand for men with creative ideas. Our course develops ability and originality. Work intensely interesting.
EARN $25. TO $75. WEEKLY
You can do it if ambitious. Successful graduates everywhere. Our course covers every phase of work completely and thoroughly. Our graduates command big salaries. Write for catalog, samples, guarantee and Free Outfit Offer.
DETROIT SCHOOL OF LETTERING, 682 D. S. L. Bldg. Detroit, Mich.

Learn Vaudeville Acting

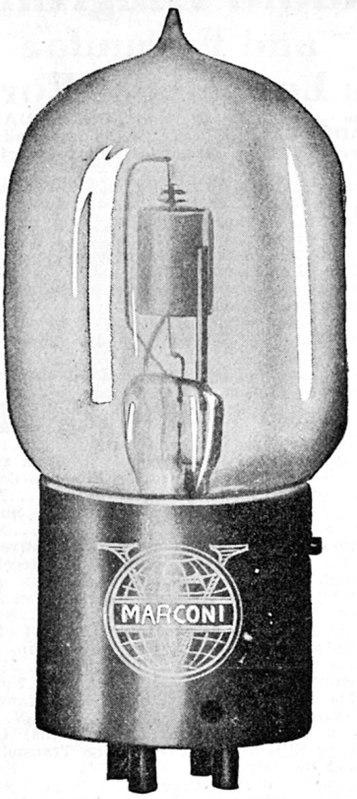
Stage Work and **Cabaret Entertaining** successfully taught by mail. Your opportunity to enter fascinating, money-making profession — to travel — see the world—as vaudeville actor or actress. My simple, easy, complete, Professional Course—only one of its kind—**COVERS ALL BRANCHES.** Develops **Personality, Confidence, Skill** and tells you **just how** to get on the Stage. Send 6c postage for illustrated booklet **"All About Vaudeville."** State age and occupation.
Frederic LaDelle, Sta. 271, Jackson, Mich.



SPECIAL KON-VER-TER SLIDE RULE
The Hamilton KON-VER-TER slide rule has over 8000 graduations and over 1800 characters on it, will handle anything in Arithmetic, Algebra, Geometry or Trig. This slide rule is in use in all parts of the world and is much simpler to operate than others of similar lines. Does not require a wizard to use it.
Eventually you will get this rule, get it now and save the extra bother and expense. Utility rules $1.00. Special De Luxe, white ivory celluloid $2.50, instructions free. Leatherette case 50c extra.
J. C. HAMILTON & CO., Dept. B 7 Water St., Boston, U.S.A.

You can be quickly cured, if you
STAMMER
Send 10 cents coin or stamps for 70-page book on Stammering and Stuttering, **"Its Cause and Cure."** It tells how I cured myself after stammering for 20 years.
Benjamin N. Bogue 763 Bogue Building, Indianapolis

Wrestling Book FREE
Be an expert wrestler. Learn at home by mail. Wonderful lessons prepared by world's champions **Farmer Burns and Frank Gotch. Free book** tells you how. Secret holds, blocks and tricks revealed. Don't delay. Be strong, healthy. Handle big men with ease. Write for free book. State age. **Farmer Burns.** 7442 Ramge Bldg., Omaha, Neb.



Fleming Pat. No. 803684
De Forest Pat. Nos. 841387-879532

A WARNING

to Manufacturers
Importers
Dealers
Jobbers
Agents
Amateurs
Purchasers
Users of

Vacuum Tubes

The Marconi V. T. Patent is Basic

United States Letters Patent to Fleming, No. 803,684, November 7, 1905, has been held to be valid by Judge Mayer of the United States District Court for the Southern District of New York, and by the United States Circuit Court of Appeals for the Second Circuit.

It is a basic patent and controls broadly all vacuum tubes used as detectors, amplifiers or oscillions in radio work.

No one is authorized to make, sell, import or use such tubes for radio purposes, other than the owners of the patent and licensees thereunder. Any others making, selling, importing or using them alone or in combination with other devices, infringe upon the Fleming patent and are liable to a suit for injunction, damages and profits. And they will be prosecuted.

THE AUDIOTRON AND THE LIBERTY VALVE ARE NOT LICENSED UNDER THE FLEMING PATENT

The price of the genuine Marconi V. T. delivered is $7.00 each. The standardized socket is $1.50 additional. The standard resistance, complete, costs $1.00 and is made in the following sizes: ½ megohm, 1 megohm, 2 megohms, 4 megohms, 6 megohms.

Do not take chances by making, importing, selling, purchasing or using vacuum tubes for radio purposes not licensed under the Fleming patent. By selling, purchasing or using licensed tubes for radio purposes you secure protection under the Fleming patent and avoid the risk of litigation for infringement thereof.

This warning is given so that the trade and public may know the facts and be governed accordingly.

Send all remittances with order to COMMERCIAL DEPARTMENT

MARCONI WIRELESS TELEGRAPH CO. OF AMERICA
RADIO CORPORATION OF AMERICA

235 Broadway New York

Sole Distributors for De Forest Radio Telephone & Telegraph Co.

Retail Office and Exhibition Rooms, 25 Elm St., New York

Schofield Bldg., Cleveland, Ohio
American Bldg., Baltimore, Md.
Insurance Exch. Bldg., San Francisco, Cal.
136 Federal St., Boston, Mass.
301 Commercial Bank Annex, New Orleans, La.
109 South 2nd St., Philadelphia, Pa.

MURDOCK No. 55

2000 OHM SET.....$4.50
3000 OHM SET..... 5.50

That these Murdock No. 55 Sets have earned a nation-wide reputation for value, is due, not so much to the fact that they are, without question, the best low priced receivers obtainable anywhere, as it is to the recognized fact that they closely approximate in operation the sensitive performance of the most expensive sets.

The customary assurance of "Satisfaction or Money Back" affords the opportunity of proving the exceptional value of these 'phones at no risk to you.

Other instruments — MURDOCK MADE—of recognized merit at equally reasonable prices are illustrated in Bulletin 19B, a copy of which will be mailed on request.

WM. J. MURDOCK CO.
55 Carter St.
CHELSEA (BOSTON 50) MASS.
509 Mission St. San Francisco, Calif.

A New
VACUUM RECTIFIER TUBE
for Wireless Telephone

absolutely the newest device on the market. Does away with motor generator. It permits you to use 110 VOLTS 60 CYCLES alternating current and rectifies this to direct current for the transmitting tube.

Get our free descriptive circular 12A

WIRELESS EQUIPMENT CO., INC.
19 Park Place New York, N. Y.

MARKO
STORAGE BATTERIES
ARE GOOD—TRY ONE
Paul M. Marko & Co., Inc.
1402-1412 Atlantic Ave.
Brooklyn, N. Y.

LIMITLESS FORCE IN ATOMS.

Some remarkable predictions are contained in a volume recently publisht by Frederick Soddy, who is Lee Professor of Physical Chemistry at Oxford, and famous for his research into the nature of elements and particularly into radium and its cognates, says the New York *Times*. He says:

"Discoveries in radioactivity have shown that in the smallest atoms of matter all around us there exist stores of energy a million times greater than any so far harnessed. Limitless physical power awaits humanity as soon as knowledge that shall lead to its control and application has been obtained. How many unrecorded ages elapsed before the energy of fuel was controlled, and in how short a space of subsequent time has it altered the whole mode of life of the world. Given a clear course, and that most rare of national qualities, common sense, physical science can abolish the struggle for existence so far as concerns food and fuel."

He holds, too, that the moon "cannot be really dead. It is, in the present state of physics, impossible to conceive of a physically dead world; that is to say, a world without any available source of energy."

Prof. Soddy has much to say of queer elements and strange atoms of alchemists' dreams of turning base metal into gold. There was nothing extravagant in them, he says. The elements can be transmuted into one another, or could be, if the atoms in them could be varied slightly. "To get gold from mercury," he says, "expel from the atom of mercury one betaparticle which will make thallium, then one alphaparticle which will turn thallium into gold, or to get gold from lead expel from one atom of lead one alphaparticle, which will turn into mercury and proceed as before."

AUTHORS, ATTENTION!!!

The editors wish to call the attention of authors of electrical, radio, and scientific articles, stories, descriptive writeups, et cetera, to the fact that owing to the increase in text space now available in the ELECTRICAL EXPERIMENTER, more articles can be used than ever before, AND AT GOOD RATES.

Sub-Sea Exploration

By JOSEPH H. KRAUS.

(*Continued from page* 984)

cles; propellers repaired; rudders and injection pipes cleaned and repaired without the necessity of shifting the cargo in order to tip the vessel up aft, so that the slight repair on the propeller or rudder could be made. Most every seaport has seen at some time or other an ocean going craft compelled to load down forward. Now at all times such work is under the direct supervision of the ship's officers and underwriting officials and no mistake as to its accuracy and the extent of damage or repair is possible. Note how easy it is to manage tools and handle them with practically the same ease and efficiency as they are handled anywhere on the surface or land. An air space is provided so that all tools, pneumatic and electrical, will function properly.

In Fig. 3 we see a method of reclaiming and recovering treasures from the bottom of the ocean. Vast treasures have lain there for ages, just beyond reach of all expert wrecking and diving methods heretofore used. All that is necessary is to go down there and reach for the treasure with hook or derrick. The operation is followed continuously by the aid of windows and in solid comfort. Here also, is a wonderful

(*Continued on page* 1076)

Radio Diagrams and Formulae in Loose Leaf Form

The publishers of the CONSOLIDATED RADIO CALL BOOK have completed the preparation of diagrams and instructions on:—

Measurement of Capacity of a Condenser. (Substitution Method.) Calibration of a Variable Condenser. Two Diagrams and Curve.....No. 1
Measurement of Inductance of a Coil or Circuit. Two Methods—Two Diagrams.....No. 2
Measurement of Distributed Capacity of an Inductance. Diagram and Curve.....No. 3
Measurement of Fundamental Wavelength of an Antenna. Three Methods. Three Diagrams.....No. 4
Measurement of Wavelength of Distant Transmitting Station. Two Methods. Calibration of a Receiving Set. Two Diagrams....No. 5
Measurement of Effective Antenna Capacity. Two Methods. Two Diagrams.....No. 6
Measurement of Inductance of Antenna and a Third Method of Measuring Effective Capacity of Antenna. One Diagram.....No. 7
Measurement of Antenna Resistance. Substitution Method.....No. 8
Schematic Wiring Diagram of Regenerative Audion Receiving Set Suitable for Receiving High Power Undamped Wave Stations. Connections shown are those used in most Navy and Commercial Receivers.....No. 50
Table giving the value of LC (Product of Inductance and Capacity) for wavelengths from 300 to 20,000 meters. Inductance in Microhenrys.....No. 100
Table same as above but with Inductance in centimeters.....No. 101
Schematic Wiring Diagram of Signal Corps Type SCR-68 Radio Telephone Transmitting and Receiving Set.....No. 51
Schematic Wiring Diagram of Type CW-936 (Navy Submarine Chaser) Radio Telephone and Telegraph Transmitter and Receiver. No. 52
Schematic Diagram of Type S.E. 1100 (Navy Flying Boat) Radio Telephone and Telegraph Transmitter.....No. 53

These diagrams and instructions are the most CLEAR, CONCISE, COMPREHENSIVE and CONVENIENT form of instruction that has ever been presented. They are printed on pages size 8½ x 11.

Complete Set of 14 Sheets as described, sent postpaid 75c

CONSOLIDATED RADIO CALL BOOK CO., Inc.
41 Park Row, New York, N. Y.

Charge Storage Batteries
For Convenience or Profit

From any alternating current lamp socket with the Cambridge Rectifier. For home or garage use. As simple as turning on a lamp and fully guaranteed.

Quickly saves its cost and doubles the life of your battery. Always ready when you want it. Rectifier Bulletin R sent on request.

Bulletin Y of Wireless Telegraph Apparatus sent for 3 cent stamp.

Clapp-Eastham Co.
131 Main St.
Cambridge, Mass.

The Cambridge Battery Charger, Price **$25**

WIRELESS Apparatus, Raw Materials, Magnet wires, motors, experimenters' needs, novelties listed in our Catalogue C-3. Assure yourself of prompt service and right prices by buying from this world famed, reliable, Experimenters' Supply House. *99 of every hundred orders received shipped within 24 hours. Catalogue C-3 FREE on request.*

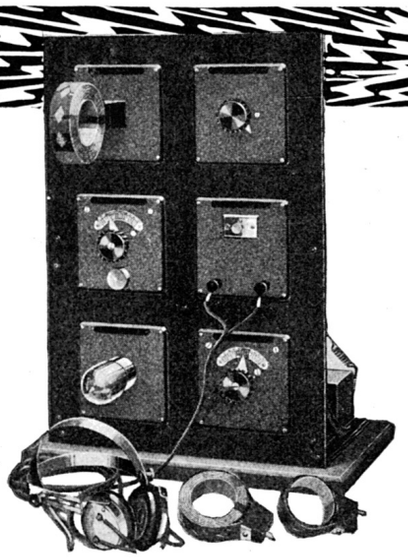
THE NEWMAN-STERN CO., Cleveland, O.

Arnold
Loose Couplers
Combination Loose Coupler Parts and accessories.

Send 3c stamp for literature which is sure to interest you.

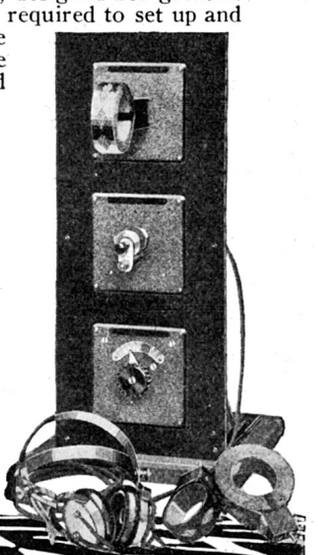
J. F. ARNOLD 2082 Lexington Av. N.Y. Established 1910

DE FOREST



The Easiest Way to Get a Radio Receiving Station

FOR the Radio beginner, or even for the experienced Amateur, here is the simplest, most satisfactory and least expensive way to secure reliable, efficient and scientific Receiving Apparatus. We have just completed two new Unit-System Receiving Sets, specially designed to give beginners and others complete outfits of the most advanced type, designed for greatest efficiency and offered as complete outfits containing everything required to set up and operate a Radio Receiving Station. Both Sets are part of the deForest Unit-System and more advanced apparatus may be added at any time without discarding previously purchased units.



de Forest Audion-Unit Radio Receiving Station

(6-panel set illustrated above)

A larger and wider range Set with Audion Detector and large assortment of "Honey-Comb" Coils, giving wider receptive facilities. 6-panels in all, with all necessary apparatus and supplies, including "B" Battery. Arranged for expansion when the owner desires.

de Forest Simplified Radio Receiving Station

(3-panel set illustrated at right)

Also complete in every detail, including short, medium and long wave-length deForest "Honey-Comb" Coils, Detector, Condenser, Head Telephones, Antennae Wire—everything needed to set up and operate an efficient Receiving Station. Complete instructions for assembling and operating included.

Send for our new booklet, "How to Set Up and Operate an Amateur Radio Receiving Station," which tells all about these new Sets. Sent Postpaid, for 10 cents in stamps.

DE FOREST RADIO TELEPHONE and TELEGRAPH CO.

Inventors and Manufacturers of Amateur and Commercial Radio Apparatus
1399 SEDGWICK AVENUE NEW YORK CITY

DE FOREST

LEARN WIRELESS RIGHT

Right in Your Own Home

We teach you Wireless by correspondence—a simple, practical method that is easy to master. Wireless is a fascinating and well-paying profession. It is in its infancy at present. Those who take this course NOW will have all the advantages for promotion and a wonderful future. Start to study *now*—there is a great demand for proficient operators.

Earn $125.00 to $250.00 Per Month

When you complete our course, you will earn a salary of not less than $125.00 per month, and as much as $250.00. Besides the salary, you are given board and quarters. Our students are thoroughly expert and secure the BETTER kind of positions.

Our Instruction is Complete

Our course is highly approved by people who are qualified to speak upon the subject. It is thorough in every respect, yet very easy to learn.

You Learn in a Short Time

Our course is extensive and complete — you can master it in a short time, ranging from ten weeks to four months — depending upon how you apply yourself.

Instruments Given Free

With the Course we give you FREE a Learning Set and Complete Text Books.

Post Graduate Course

Every student who completes the course is entitled to a month's tuition FREE at the school in Baltimore.

We Get You a Position

Our graduates are in demand by The Shipping Board, The Marconi Co., The Independent Wireless Telegraph Co., etc. We guarantee to secure you a position.

LITERATURE FREE

Southern Wireless Institute
Dept. R., 423-425 Courtland St., Baltimore, Md.

Please send me your literature about Wireless. This does not place me under any obligation whatever.

Name .....

Address .....

City .....State .....

"RW4," Size 12" x 9" x 6½"

MIGNON "RW4" UNDAMPED WAVE RECEPTORS

NO Loose Couplers
Loading Coils
Variometers
Amplifiers

Strongest, Most Distinct Signals

IMPORTANT—NOTICE

Ernest C. Mignon, inventor of the famous disc-core undamped wave receptor, is no longer connected with the Mignon Wireless Corporation, of Elmira, N. Y., or their successors—the Universal Radio Mfg. Corp. Address all communications for Mignon apparatus to

MIGNON MANUFACTURING CORPORATION, Newark, N. J.

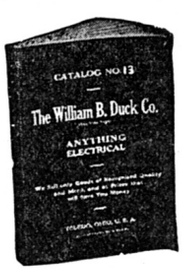
DAMPED AND UNDAMPED WAVE APPARATUS FOR ALL PURPOSES

Endorsed by Radio Department of D., L. & W. R. R. Co.

Write for Literature.

MIGNON MFG. CORP.
NEWARK, N. J.

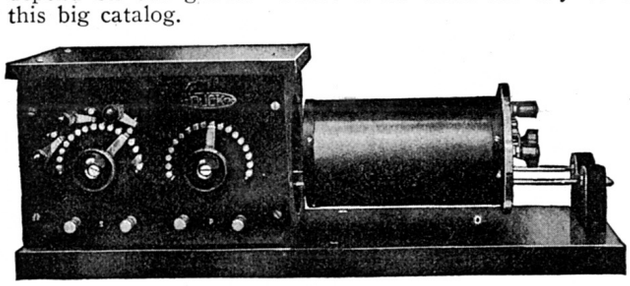
SUPERIOR MIGNON SYSTEM APPARATUS



DUCK'S

New Big-264 Page No. 13 Wireless and Electrical Catalog

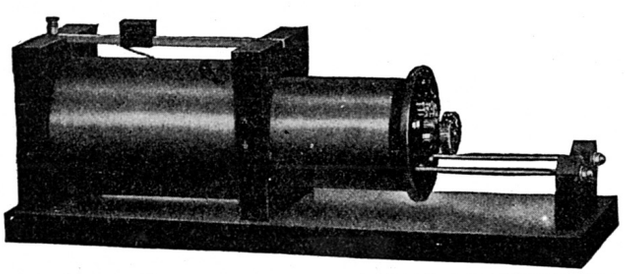
Will be mailed for 12c in stamps or coin which may be deducted on first order of $1.00. Catalog not sent otherwise. We regard this catalog as our greatest effort. It embraces everything in wireless worth while. 172 pages with no waste space devoted exclusively to wireless instruments. Your amateur friend will tell you that there never has been any wireless catalog to take the place of catalog of this company and above all that you can absolutely depend on our goods. There is no need for any other catalog when you have this big catalog.



A big improvement over our former model. Primary divided into four sections, with three dead end switches, greatly improving selectivity.

Secondary divided into three sections, with two dead end switches, eliminating harmonics. The change in the construction of the guide rod support makes it possible to obtain a looser coupling. It is a wonderful improvement over our old model both in performance and appearance. Only $23.50.

NEW MODEL 5BB. NAVY TYPE RECEIVING TRANSFORMER



The secondary on our new type Arlington is divided into three sections with two dead end switches eliminating dead end effect and harmonics and giving greater selectivity. The end support is similar to that on our Navy type permitting a looser coupling. It is a beautifully finished instrument.

Price only $10.50.

OUR IMPROVED ARLINGTON RECEIVING TRANSFORMER

THE WILLIAM B. DUCK CO., 230-232 Superior St., Toledo, Ohio

Sub-Sea Exploration

(*Continued from page* 1074)

opportunity for the biologist, the scientist, the naturalist, the treasure hunter and explorer, and all others who wish to increase their knowledge of the vast underseas, a region three times as great as the land.

The order comes down from a high official to go to the base of a great bridge to make some repairs. Do we send for a diver? Indeed not. We take a little trip, not in a diving suit, but under ordinary atmospheric pressure, and when we come up, we are satisfied that we have seen and know exactly what the trouble is, know what to order, and—we can superintend any construction work right on the spot, (Fig. 4).

Scene 5, depicts the application of the apparatus for drilling and blasting rock under water. Why should we spend hundreds of thousands of dollars for blasting rocks and bolders and send divers down with expensive drilling instruments, when we can place any man experienced with the tools down the tube and let him work under atmospheric pressure. We can personally superintend the work and experts as well as other hardy workers can operate a tool or wield a hammer regardless of whether they are accustomed to heavy air pressure, or not. The flexibility of the entire tube construction prevents the operating chamber at the bottom from rocking even tho the surface waters are agitated by wave motion or passing vessels.

All cable repairs can be done without the necessity of grappling for the cable, pulling it up and attempting to repair it, even tho gales, thunder storms, and cold spells are holding sway; by simply underrunning them and repairing them right on the bottom. In fact, telephone and telegraph cables lying under water, can be inspected as frequently as found necessary. This method is clearly illustrated and the ease of operation demonstrated in Fig. 6.

Taking of under-sea photographs and motion pictures and its practical results shown in Fig. 7 has already been described and needs no further mention.

In Fig. 8, we see, sponge fishing and oyster fishing via the new method. Formerly, grappling irons were used to tear these sponges from their bases. These realms are now open to the practical man, taking him down to the hitherto unexplored areas and enabling him to obtain the more perfect, and valuable specimens, larger than can be obtained otherwise. Pearls, amber, corals, sea fish, and in fact all commodities upon which extreme prices are being laid, will offer their vast fields to the practical individual.

Gold mining, Fig. 9, is one of the industries over which men have fought and even killed each other in an attempt to procure the precious metal. Mountain streams carry down large quantities of the already washed material—why not get the gold there? The method here depicted enables the operator to sit on the bottom of a nice warm chamber, and proceed to wash some of the nuggets out of the gravel and sand. He works in practical comfort, and when he gets tired, can be replaced by his partner.

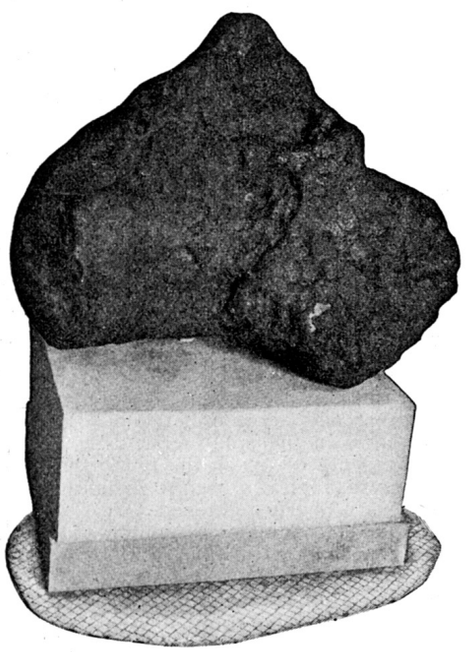
Captain Williamson's device promises many radical departures and attainments in all kinds of under-sea work. There is a dual project being proposed, under direct supervision of Captain Williamson, and it will be well for those whose interest lies in this particular kind of work, to keep their eyes on the columns of this magazine for an event which will undoubtedly startle those interested in subaqueous exploration, construction and salvage work.

Popular Astronomy
Meteorites

(*Continued from page* 1009)

microscopic examinations of meteorites have yielded any results that could be interpreted in favor of such a view.

Falls of meteorites are accompanied in nearly every instance by terrific explosions and sharp reports that can be heard for many miles around often causing the ground to shake as in an earthquake. The meteorite itself has been described as resembling a ball of fire or the headlight of a locomotive and is followed frequently by a trail of light or a cloud of smoke. At the time it enters our atmosphere a meteorite is moving with planetary velocity ranging from two to forty-five miles per second. Its interior is intensely cold, approaching in temperature the absolute zero of interplanetary space, and it is, therefore, far more brittle than it would be at ordinary temperatures. As it ploughs its way into the earth's atmosphere its surface temperature is soon raised by friction to at least 3000° or 4000° C. which is sufficient to fuse all surface materials into the characteristic black crust with which stony meteorites are coated.



"The Woman" Meteorite—in the American Museum of Natural History Collection, at New York City. Found at Cape York, Greenland.

Meteorites are usually first seen at an altitude of fifty or sixty miles. Altho they are moving with a velocity comparable to that of the planets, when they enter the earth's atmosphere, this velocity is so rapidly reduced by friction with the atmosphere that they usually drop to the surface of the earth with a velocity about equal to that of ordinary falling objects.

The flight of a meteorite often extends over a path several hundred miles in length and the meteorite may be seen by many observers in several different states and yet finally fall in some unknown spot and never be found.

The evidence gathered regarding the actual fall of meteorites is often contradictory. Some stones are too hot to handle for hours after they fall, others are merely warm, while still others have been picked up cool or even intensely cold. Meteorites have been seen to fall upon dried grass and upon straw without producing even charring effects. The evidence regarding the depths

"ASK ANYONE WHO HAS USED IT"

"Light and Sensitive. The Mechanical Construction Is Good and They Look Very Neat." (NAME ON REQUEST)

This extract from the letter of a satisfied patron is in line with what they all say.

BRANDES WIRELESS HEADSETS

CLEAR TONE LIGHT WEIGHT
DEPENDABLE SERVICE

Score 100% efficiency in actual use. Sharp, Unblurred, Readable Signals assured by

"Superior" Set, 2000 ohms, $7

"BRANDES MATCHED TONE"

Exactly matching the tone of both receivers in each set and thus eliminating all confusion due to unmatched harmonics.

TRIAL OFFER

Buy a Brandes Superior Headset and use it critically for ten days. Then, if it doesn't come up to our claims or your expectations, return it and your money will be cheerfully refunded. Test it—compare with others—for sensitiveness, clearness, distance. Prove for yourself the fine quality, the "matched tone." The two diaphragms toned exactly alike, strengthen the signals and prevent blurring. Used by many U. S. Government experts, and experts abroad; by colleges and technical schools; and by professionals and amateurs everywhere.

SEND 4c FOR CATALOGUE E

C. BRANDES, Inc.
Room 814
32 Union Square
New York City, U. S. A.

WIRELESS RECEIVER SPECIALISTS

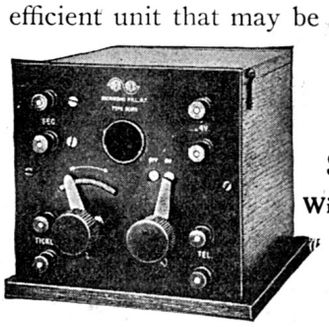
Complete Line of Brandes Receivers for those in Canada. Send stamp for Pamphlet "E"
Radio Electrical Supply Co., 43 McGill College Avenue, Montreal, P. Q., Can.

The Latest Audion Control Cabinet

Here is a compact and highly efficient unit that may be used with any and all receiving circuits.

The GREBE RADIO

Audion Control Cabinet Type RORH



Price, $17.00 Without Tube

contains the grid condenser, grid leak, filament rheostat and two 20-volt dry batteries. Socket accommodates the standard 4-prong tube.

There are binding posts for secondary, tickler, phones and filament battery.

Direct and simple connections may be made to all types of receivers.

Free bulletin R-117 describes this unit. Complete catalogue, 10 cents.

A. H. GREBE & CO., Inc., 70 Van Wyck Blvd., Richmond Hill, N. Y.

AMAZING OPPORTUNITIES in the Airplane Industry

Right now is your opportunity to get into the greatest industry the World has ever known. Thousands of new positions opening up everywhere in this attractive new field. Never before have ambitious men had such a glorious chance. Send Coupon at once—find out how our wonderful Course in Practical Aeronautics will give you the knowledge to enter this new field. Learn at home by mail during your spare time.

Prepare NOW for these positions
Aeronautical Engineer
Aeronautical Instructor
Aeronautical Contractor
Aeroplane Repairman
Aeroplane Mechanic
Aeroplane Inspector
Aeroplane Salesman
Aeroplane Assembler
Aeroplane Builder

Enormous Demand for Men—Big Pay
If you know Practical Aeronautics, some big Airplane Corporation will want you. Unheard of Salaries are being paid trained men. Act at once. The pioneers are going to reap the big rewards. Automobile history, railroad history, movie history will repeat itself in Aviation

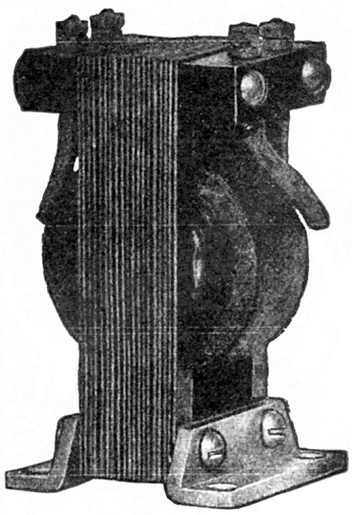
Special Offer NOW—Send Coupon
Send the Coupon at once for full particulars of our remarkable offer open to you now. We will also send you our big new book "Opportunities in the Airplane Industry." No obligation. Be sure to tear off and mail coupon today.

AMERICAN SCHOOL OF AVIATION
431 S. Dearborn St. Dept. 7992 Chicago

FREE BOOK COUPON

American School of Aviation
431 S. Dearborn St., Chicago
Dept. 7992
Gentlemen: Please send me full particulars of your remarkable offer, also your new big book "Opportunities in the Airplane Industry." I assume no obligation.

Name.....
Address.....



TRIODE
(TRADE MARK)
Audio Transformer Type P

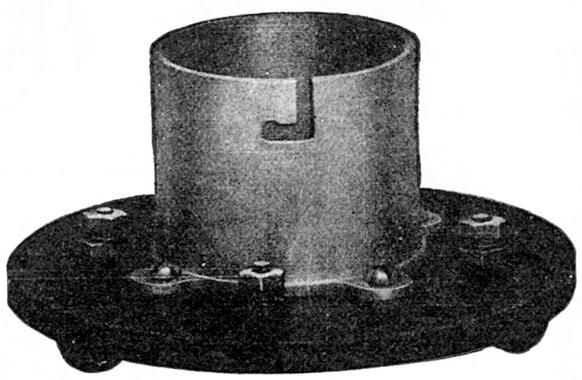
This transformer provides a maximum of low frequency amplification and is superior to all others. It may be used with the Marconi and all standard vacuum tubes.

Permits reliable daylight reception from European stations.

Establishes new amateur long distance records.

Renders remarkable amplification of all signals.

Price $7.00 postpaid



TRIODE
(Trade Mark)
Vacuum Tube Socket Type F

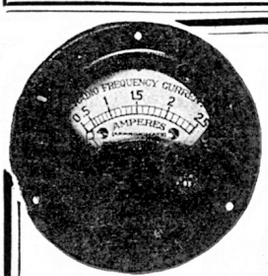
The base of this socket is bakelite dilecto and will not crack and break like the moulded material of the usual socket.

Contact springs are stamped with identifying letters. Base is provided with three rubber feet and four countersunk holes for panel mounting.

Price $1.25 postpaid

EATON OSCILLATORS TWO STEP AMPLIFIERS
DAMPED AND UNDAMPED RECEIVERS
FARADON MICA TRANSMITTING CONDENSERS

WIRELESS SPECIALTY APPARATUS CO.
ENGINEERS, DESIGNERS, MANUFACTURERS
Boston, Mass., U. S. A.



Is Your Transmitter Really Tuned?

You may think it is, but you don't know unless your station is equipped with a reliable Antenna Ammeter.

These Roller-Smith Hot-Wire Ammeters were made for the U. S. Army Air Service for use on fighting planes.

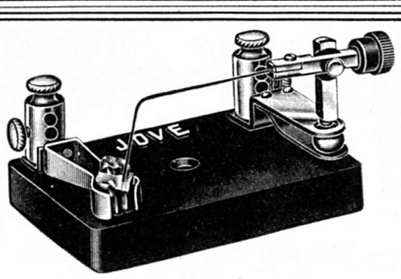
Regularly $13—Our Special Price $7

With the Armistice came a cancellation of contracts and these Ammeters, which had successfully passed the exacting Government tests, were returned to the manufacturers. Each is in perfect condition, packed in its original carton and ready for immediate shipment.

The scale reading is: 0-2.5 Amperes. Shunt giving double or triple this range, 75c extra.

By buying the entire surplus we are able to sell these Ammeters at less than the Government paid for them in lots of one thousand. Better order yours today as this may be your last chance. Remit by check or money order.

A. H. GREBE & CO., Inc. 70 Van Wyck Blvd., Richmond Hill, N. Y.



Jove Detector (Patented)

Bunnell Instruments Always Satisfy—

Our Jove Detectors Simplest and Best--
Sample by Mail, $1.80
Tested Galena Crystals, 25c per box.
Our Keys, Spark-Gaps, Condensers, Transformers, etc., are High Grade, but inexpensive.

Send Stamp for our New Catalog 42 E.
J. H. BUNNELL & CO. 32 Park Place, New York
(Marconi Licensee)

to which meteorites penetrate the ground is quite as conflicting. The largest of all the stony meteorites which fell at Krnyahinya, Hungary, weighed 647 pounds and buried itself to a depth of eleven feet. Yet Peary's Cape York iron weighing 37½ tons was only partially covered and showed no signs of abrasions of surface resulting from the fall.

The Willamette iron meteorite weighing 16½ tons lay in a forest when found and was not deeply buried. The Bacubirito iron weighing 20 tons lay in soft soil barely beneath the level of the surface. On the other hand a fragment of a stony-iron meteorite, weighing 437 pounds, that fell at Estherville, Iowa, buried itself eight feet in stiff clay.

There are no well-authenticated instances of any persons or animals being killed by falls of meteorites or of conflagrations being started by such means.

The Electrical Machinist

By H. WINFIELD SECOR.

(*Continued from page* 1023)

size is drilled thru the bar. This is then filed out with a small square file, until it just accommodates a piece of about ¼ inch self-hardening steel. This tool point is held rigidly in position by means of a steel set screw. This is usually a tempered steel or case-hardened screw. The cutting edge should be ground to a diamond point with plenty of clearance, as shown in Figs. 2-B and 2-C.

If the field casting is completed and does not have separate pole-pieces bolted into place within the polar ring, then this casting can be bolted or clamped on to the lathe carriage or else to the lathe bed itself in any suitable manner. The casting does not move cross-wise, but successive increase of "cut" of the boring tool are made by loosening the set screw and advancing the tool point slightly. The carriage can then be traversed while the tool is cutting and a cut first taken across and then back on the pole-faces. Don't forget to use plenty of oil on the tail-stock center and see that the *dog* used to drive the shaft firmly is properly tightened.

Where a casting of any appreciable size is to be machined in this fashion, a double tool boring bar shown at Fig. 2-C is preferred. This causes a balanced pressure in cutting and not only lowers the strain on the cutting tools and bar, but gives a much more even cut and finish to the work.

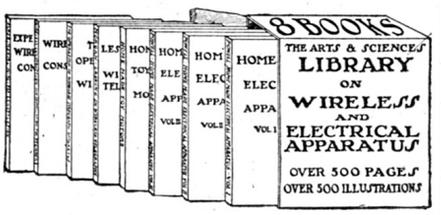
REVOLVING THE CASTINGS WHILE MACHINING.

In many cases, even with fairly large castings, the polar boring as well as the machining of the front and rear faces of the yoke and complete casting are accomplisht by clamping or bolting the casting to the face plate of the lathe. This is a very good method, indeed, and is practised in a great many electrical manufacturing and machine shops.

In this case the machining operations are all carried out by means of boring-out tools supported in the usual tool post on the lathe carriage. At Fig. 3 the operation of boring out the pole-faces of a two-pole motor casting is shown. As will be evident, the desired diameter of the polar bore is obtained by gradually increasing the cut with the boring-out tool, until a sufficient amount of iron shall have been removed. Before removing the casting, and while it is in this position on the face plate, it is the best practise to then machine off the yoke ring against which the bearing housings are to abutt. When this has been done you have a true face as a guide, and which is parallel with the finished polar bore axis, so that when you loosen the casting and reverse it on the

The Arts and Sciences Library Contains

8 BOOKS — OVER 500 PAGES and OVER 500 ILLUSTRATIONS



Showing You in the Simplest Form How to

Make Your Own ELECTRICAL AND WIRELESS APPARATUS

of Every Conceivable Kind

Complete set in corrugated container, to keep them clean and new.

ONLY $2.75 POSTPAID

the best book bargain and the most complete source of information for beginners and more advanced experimenters for making APPARATUS on the market today.

If not worth $5.00, send them back in 10 days and we will refund your money.

ORDER AT ONCE THIS EDITION GOING FAST

COLE & MORGAN, Inc., *Publishers*
Dept. 114, 19 Park Place, New York

Radio Operators

earn $125.00 per month and up, plus all expenses

Modern Equipment
Special Short Course
Individual Instruction

Call or write for illustrated booklet and full information regarding special privileges included in tuition fee.

Y. M. C. A. Radio School
Dept. R
152 East 86th Street
New York, N. Y.

"Best Radio School in the East"

SUPERLATIVE RADIO EQUIPMENT
THE BEST KEY IN THE COUNTRY
10 Amp. $7.75—20 Amp. $8.25
A three cent stamp will bring bulletins of this and other higher grade apparatus.
THE RADIO ENGINEERING COMPANY,
22 St. Paul St., Baltimore, Md.

READ THE CLASSIFIED ADS. ON PAGES 1092-1095

face plate, it will then be in an exactly parallel position for tooling off the second yoke face. When this has been done, you will have the back and front yoke rings as well as the polar bore finished, and all of them parallel to one another.

MACHINING SEPARATE POLE-PIECES ON THE FACE PLATE.

Many dynamos and motors today are built with unit or independent pole-shoes and magnet cores, as shown at Fig. 4, and unless this has been accurately built up from steel punchings, as they are in some electrical machines, they will have to be accurately machined or turned on both front and rear to the proper diameter. It is usual to machine either a two, four or six pole magnet layout at the same time. They should be thoroly clampt to the face-plate by means of clamping bars placed over the pole-shoes and bolts are then past thru these to the back of the face plate, where they are held firmly in place by nuts and washers. When setting the several pole-pieces into position they should be accurately lined up first for their position on the angular displacement of the poles, i. e., 90° apart for a four pole field, 60° apart for a six pole field, etc.

The New Theory of Electrical Mass

By ROGERS D. RUSK, M.A.

(*Continued from page* 1014)

passed. For convenience the simple field only has been indicated and not the complete electric and magnetic field.

This deduction that energy itself in the form of electricity may have mass is quite in agreement with still other experiments in which it has been proved that energy in still other forms may exert a pressure and exhibit the property of mass. For instance, it has been proved *that light waves can exert a pressure,* and it has been shown that other forms of radiation possess inertia which is the distinctive property of mass. Perhaps we shall some time have to change the old definition we used to use that matter is anything that possesses inertia. *Perhaps, after all, mass is a property of energy and matter itself is only an expression of energy.* The question has not been finally settled, but we can speak with some assurance about the negative electron. Concerning the positive particle we have yet to hear. One thing more, however, is in favor of the electrical theory of mass, and that is that the positive nucleus of the atom, in which the most of the weight is concentrated, appears from mathematical considerations to be much smaller even than the electron. If this is true it could hardly consist of anything very material.

Experiments In Physics

By JOHN J. FURIA, A.M.

(*Continued from page* 1015)

as to correspond to the natural frequency of vibration of the bell. Shortly the heavy bell is set ringing. Mere random pulls would practically not disturb the bell at all. When an army crosses a bridge, the commanding officer gives the order to break step. The army in step would give to the bridge a series of impulses of definite timed frequency and the bridge would slowly be set in vibration. The vibration might very easily cause the bridge to collapse. When the wireless amateur wishes to hear his friend, he tunes his set, *i. e.,* varies his inductances and capacities so as to make his outfit have a natural frequency equal to that of the incoming signal.

(*Next installment will appear in an early issue.*)

No Other Typewriter Can Do This:

MULTIPLEX HAMMOND'S
Instantly changeable type
Many styles, many languages
Two types or languages always in the machine
Just Turn the Knob to change

The World's Most Wonderful "Writing Machine"

Here's a polyglot machine that writes all languages from Eskimo Indian to Kata Kana Japanese. There are over 365 different type-sets to choose from. The type is instantly interchangeable—two different languages or type-sets are always on the *ONE* machine. You "Just turn the knob"—to change language or type.

Hammond MULTIPLEX

MANY TYPEWRITERS IN ONE

Sounds like an Arabian Nights story—but the machine itself is very practical, very real. It is the typewriter President Wilson uses personally—the typewriter he took with him when he visited King George.

Types for all purposes
and for all languages
Spacing to suit size of type
Perfect alignment
Automatic Type Impression
All on one MULTIPLEX

The marvelous, INSTANTLY *interchangeable type feature* is only one of the many reasons why thousands of prominent men and women in all walks of life prefer *and personally* use the Multiplex.

For the Mathematician, Engineer, Chemist, Astronomer, Surveyor, Navigator—there is no typewriter like the Multiplex Hammond! The Multiplex does many things that no other typewriter can do!

The Mathematical Multiplex contains the characters and signs used for writing in higher and lower mathematics, and for engineering, mechanics, etc., as well as for all the ordinary work that can be done on any typewriter.

THE HEART OF THE HAMMOND

WRITE FOR FREE BOOKLET showing the many languages and type sets of the Multiplex—there's a type for every profession, every business, every science, including technical signs and symbols and chemical keyboard.

Write your name, address and occupation on the margin of this page **NOW** and mail to

HAMMOND TYPEWRITER CO.
589 East 69th St. New York City

Also an Aluminum PORTABLE Model. 11 lbs. Full capacity. Ask for special Folder.

AMPLIFY YOUR RADIO SIGNALS

With the new DETECTAGRAPH-TRANSMITTER, the amateur can amplify radio signals to such an intensity that he can hear the signals about his station without the need of the telephone head set.

By the addition of a loud talking telephone he is able to hear the messages many feet away from the instrument.

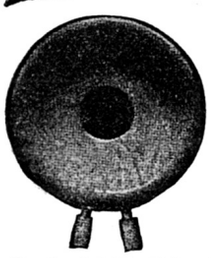
The super-sensitive DETECTAGRAPH-TRANSMITTER herewith shown is two and three-eighths inches in diameter, five-eighths of an inch thick and weighs less than three ounces. It is the most sensitive sound detecting device ever brought before the public.

The manner in which the amplifying process is attained is by attaching with tape the DETECTAGRAPH-TRANSMITTER to the regular wireless receiver.

Not only is this instrument applicable for amplifying radio signals, but it can be used with equal satisfaction for magnifying other sounds. Phonograph music can be transmitted from one place to another by means of this instrument, and those who are afflicted with deafness will find enormous benefit by using this transmitter. It is the greatest device for building your own loud talking telephone, detectagraph and other devices. Can be used for any purpose where a sensitive detecting instrument is required.

SUPER-SENSITIVE Detectagraph MICROPHONE DEVICES

Our Super-Sensitive Detectagraph Transmitter. Price, $8.00 Complete



Our Special No. 25 Loud Talking Receiver. Price, $4.50 Complete

Detectagraph Rheostat, especially made for amplifying circuits. Price, $2.00 Complete

Super-Sensitive No. 40 Receivers to be used in connection with Detectagraph-Transmitters, $10.50

The Detectagraph Junior Deaf-Phone $18.00

Equal to any $35 instrument made. Outfit consists of Super-Sensitive Transmitter with cord connector; Super-Sensitive Ear Piece with small black cord; Black Single Headband; Black Case and Two Batteries.

Adjusted Model "B" Horn, with No. 20 High Grade Loud Talking Receiver, Cord Plugs and Desk Stand Base. Price, $12.00 Complete

Adjusted Model "C" Horn, with No. 20 High Grade Loud Talking Wall Receiver, Cord Plugs and Wall Base. Price, $12.00 Complete

Detectagraph $18.00

This detecting instrument of marvelous sensitivity can be used for detecting secret conversations. Outfit consists of Sensitive Transmitter, 25-ft. Black Cord, Receiver, Headband, Case and Battery.

Order direct from ad.

Or write for free descriptive circular.

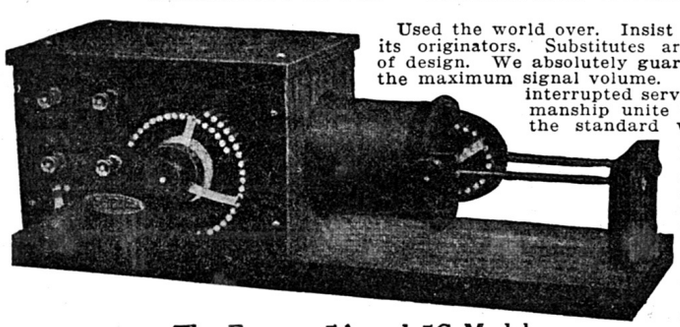
G. BOISSONNAULT COMPANY

26 CORTLANDT STREET NEW YORK CITY

Makers of Super-Sensitive Microphone Devices

TRACO QUALITY

RECEIVING TRANSFORMERS



Used the world over. Insist on the genuine, built by its originators. Substitutes are expensive, irrespective of design. We absolutely guarantee our tuners to give the maximum signal volume. Delicate refinement, uninterrupted service and high class workmanship unite to make TRACO tuners the standard whereby all others are judged. If you Dealer does not handle them, order direct from us.

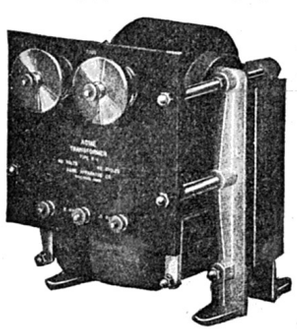
LIBERTY DETECTOR VALVES. RADIO AMPLIFYING PHONES, type used by the **UNITED STATES, BRITISH** and **FRENCH GOVERNMENTS,** now in stock, for sale.

Send stamps for bulletins.

The Famous 5A and 5C Models

THE RADIO APPARATUS CO., Pottstown, Penna., U. S. A.

WHEN YOU BUY A RADIO TRANSFORMER



1 Get One That is Efficient, every Watt saved increases Radiation.

2 Get One of High Power Factor, which means higher Efficiency and less trouble with the house lights.

3 Get One That Draws Full Rated Power, on a Condenser small enough to allow sufficient Coupling for 200 Meter Work

4 Get One Properly Designed for Rotary Spark Gaps. (If you use a Rotary Gap.)

5 Get One with Low Power Step for Short Distance Work, don't jam every one who is working at the same time.

In Other Words Buy An ACME. No other Transformer combines all these Qualities, in fact very few have even two of these Good Points.

ACME APPARATUS CO., Cambridge, Mass.

The Versatile Audion

By H. WINFIELD SECOR

(*Continued from page* 1000)

audion amplifier and signals from far distant ship and shore radio stations which cannot even be heard with a crystal detector and telephones, become clearly audible and readable with the audion amplifier, when it is connected up to the receiving set.

It is interesting to recall that several years ago, when the first radio transmission was attempted between San Francisco and Honolulu, that the signals from Honolulu would die out as sunrise approached, and the dots and dashes which had been coming in very faint during the night, would fade away to zero and become absolutely inaudible even with the most sensitive detectors and high resistance telephones. Audion amplifiers were then tried in the receiving stations in San Francisco, and reception was maintained and kept up for several hours after sunrise, due to their marvelous detecting and amplifying properties. In other words, they actually "made something out of nothing," as the radio operators said. See Fig. 3.

AUDION ORGAN GIVES PUREST MUSIC.

Fig. 4 shows what we may call the "audion organ," and this was described in the December, 1915, *Electrical Experimenter*, together with a large illustration of the device as well as a diagram of the connections for producing pure musical notes or any number of notes with one or more bulbs. This device brings out one of the prominent characteristics of the audion, i. e., that once it has been set to oscillating under certain capacity and inductance circuit conditions, it will invariably maintain this condition for an indefinite period and, furthermore, the frequency of the oscillation or the rate at which the circuit vibrates will depend upon the capacity and inductance in the circuit connected to the audion.

Thus, by having a set of keys connected to various taps on the inductance coil, so that differing amounts of inductance can be interposed in the circuits, various tunes can be played even with a single bulb, and when more than one tune is to be played, or chords, a number of bulbs will have to be used as shown in the illustration. A very pure sweet note is produced by the audion in this fashion, a revelation even to the ear of the trained musician.

AUDION TELEPHONE AMPLIFIERS AND REPEATERS.

It is well known today that *Transcontinental Telephony* was made possible by the audion repeater and amplifier. It is conceivable that, had not the audion been invented and developed to the stage that it was a few years ago, when the first transcontinental telephone line was put into successful operation, that some other form of successful telephonic repeater and amplifier would have been invented, altho 20 years of experiment by telephone engineers had failed to produce such an amplifier; but one thing is certain,—it would surely have been a very difficult, and we might almost say unnecessary task, to endeavor to devise a more efficient and reliable telephone amplifier or repeater than the vacuum valve. Audions are placed at several points along the transcontinental telephone line, such as at Chicago, Denver, etc.

This telephone circuit is about 3,500 miles in length and one can pick up the receiver in New York and hear the voice on the Pacific Coast just as perfectly as if he had simply called up his suburban home 15 or 20 miles out of town. See Fig. 5.

MULTIPLEX TELEGRAPH AND TELEPHONE.

About a year ago the American Telephone and Telegraph Company demonstrated over a circuit between New York and Pittsburg, as well as on several other circuits, that it was successfully and accurately transmitting and receiving several telephone messages over a *single wire* at the same time, by utilizing audion generators of high-frequency currents, each frequency having a different value so as not to interfere with the others.

Major-General George O. Squier was the first to suggest the application of such currents to the multiplex telegraph and telephone system and took out patents on this system about ten years ago. The test conducted by the A. T. & T. Co. demonstrated conclusively that his "stunt" would certainly work.

At the present time the first cost of the necessary apparatus for producing the essential high-frequency currents prohibits it from being adopted, except over certain circuits, and particularly under military conditions, where this scheme is of undeniable and invaluable advantage, which may often have to be made use of. For example, imagine the advantage a military unit would possess when but one wire exists between two widely separated points and instead of sending but one telephone message or current over this wire, five or six could be sent over it simultaneously, while *telegraph* signals could also be exchanged over it while the *talking* is being carried on, without any interference.

Such is the work of the *multiplex telephone* backed by the Audion, where the audion generator is used for producing each frequency. A different frequency is used for each telephone message. See Fig. 6.

LOUD SPEAKING TELEPHONE.

In the old days, especially at the circus and theater we were accustomed to hear the voice amplified at times by means of a large megaphone, thru which a person endeavored to shout. But the voice was invariably muffled and did not sound as clear as the original by the time it reached you. Now, thanks to the audion amplifier, the human voice can be amplified until it is so loud that it will almost scare you to death, and always it is articulate and distinct.

Some months ago, while the Victory Liberty Loan was under way, there was installed a remarkably loud and powerful voice amplifier along Victory Way, on Park Avenue. Fig. 7 illustrates this installation, where the voice of the speaker was amplified until it was *equivalent to approximately* 100 *H. P. of energy*. In other words, you could speak with a "100 horsepower voice" if you happened to be one of the select few who addrest the thousands gathered along Victory Way during their daily exercises. In some cases the speaker was located in Washington; his voice was then transmitted telephonically over special leased wires to the audion laboratory on Victory Way and there amplified, whence the powerful intensified voice travelled along the wires above Victory Way to a series of loud-speaking telephones provided with large horns, and in this way thousands of people could hear the voice at the same time.

TELEPHONE MODULATOR FOR HIGH-FREQUENCY ALTERNATOR.

This application is illustrated in Fig. 8. The audion is often used as a telephone modulator, especially in connection with high-frequency alternators, or dynamos, rated at say 200 K.W. or 270 H.P. as in the installation at New Brunswick, N. J., where the Alexanderson alternator is making some very remarkable radio history. Here vacuum bulbs of the audion type, known as *Pliotrons*, used in connection with an ordinary microphone such as that

A Concentrated Electrical Training

along every line of electrical and industrial enterprise insures you a position of importance, with attractive salary, upon your graduation from the School of Engineering of Milwaukee. And in addition to your specialized *technical* knowledge you will possess business and commercial adaptability — an invaluable asset for success.

You May Become an Electrical Specialist in One Year

in the greatly enlarged and perfectly equipped laboratories, shops, drafting rooms and class rooms under the direction of a large staff of well known instructors, specialists in their respective fields. Practical methods plus actual electrical experience while you learn, assures real success!

The School of Electrical and Mechanical Drafting

will train you in 1 year for a high grade position as a first class draftsman and designer. Unlimited demand for draftsmen.

Institute of Electrotechnics

Junior and Senior units—1½ years each—fits eighth grade graduates or those with 2 years of high school for worth while positions in new branch of electrical and industrial specialization. Also prepares for entering College of Electrical Engineering granting B. S. Degree in 3 years.

You May "Earn While You Learn" If You Like

All courses at School of Engineering of Milwaukee provide opportunity for part time employment on the half day or alternate week plan. Insures practical experience with chance to earn expenses while attending school. Extension Department students' "Frat" house—Room and board at cost. R. O. T. C. (optional). All athletics.

New Term Opens April 1st

Send NOW for Free illustrated bulletin and full particulars.

SCHOOL OF ENGINEERING OF MILWAUKEE

157-373 Broadway, Milwaukee, Wis.

"An Electrical Technician's Institute."

School of Engineering of Milwaukee,
157-373 Broadway, Milwaukee, Wis.

Gentlemen:—I am interested in the courses marked below. Kindly send illustrated catalog and full particulars FREE!

..School of Practical Electricity—One year course.
..School of Mechanical and Electrical Drafting—One year course.
..Institute of Electrotechnics.
..Extension Department

Name .....
Address .....
Age .....Education .....

STORAGE BATTERIES FOR WIRELESS SERVICE

Batteries especially adapted for the amateur operator are described and illustrated in our new Bulletin No. 175, copy of which will be furnished on request.

THE ELECTRIC STORAGE BATTERY CO.

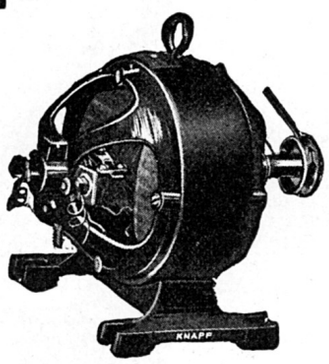
The largest maker of storage batteries in the world
1888 PHILADELPHIA, PA. 1920

New York Boston Chicago Washington Denver San Francisco Cleveland
Atlanta Pittsburgh Minneapolis Kansas City St. Louis Detroit Rochester
Special Canadian Representatives, Chas. E. Goad Engineering Co., Toronto and Montreal

DEPENDABLE KNAPP ELECTRIC SPECIALTIES

Motors, Electrical Toys and Specialties are Best

Knapp Goods have stood the test for 29 years. No detail in construction has been spared to make them the best that money can buy. The complete Knapp line includes Toy and Power Motors, Generators and Dynamos. Specialties and Novelties that amuse and instruct. Fans, Rheostats, Compasses, etc. And Knapp prices are always lowest. Always insist on Knapp Goods.



KNAPP DYNAMO MOTOR

Will electroplate, charge storage batteries, run lamps, motors, train of cars, induction coils,—in fact, the number of experiments it can be used for is unlimited. Runs on 4 to 6 Volts or can be connected to run on 110 Volts through a transformer.

Price, complete, $8.80

KNAPP "LEARNELECTRICS"

A complete Electrical Laboratory, including a very valuable instruction book by H. P. Gorman, A.I.E.E. Covers all subjects clearly and concisely.

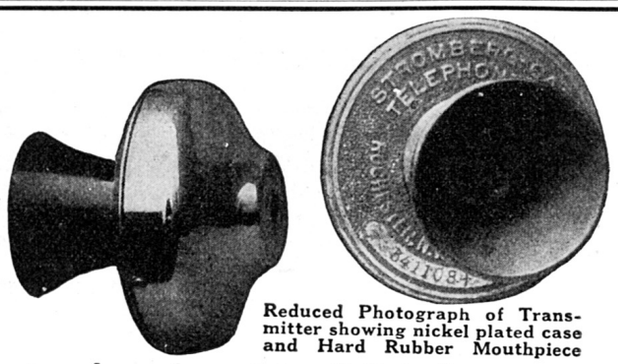
Price, complete, $4.40

Order to-day. Or your dealer can secure them for you. DESCRIPTIVE CIRCULAR and CATALOG of celebrated **KNAPP MOTORS** *and Electrical Specialties from 10c up mailed FREE on request*

KNAPP ELECTRIC & NOVELTY CO., 523 West 51st Street, New York City

SPECIAL SALE!

We have on hand 2,000 Carbon Grain Transmitters as per photograph. They are first-class instruments and may be used for all kind of experiments, especially for wireless telephone sets, where a heavy current is to be passed through. Slightly used, but in perfect working order. Money refunded if not satisfied. A real bargain. Order one or more today.



Reduced Photograph of Transmitter showing nickel plated case and Hard Rubber Mouthpiece

$1.00 ONLY

Postage extra.

Ship. Weight, 2 lbs.

Diameter, 3¼ ins.

THE ELECTRO IMPORTING CO., 231 Fulton St., NEW YORK

Wireless Amateurs, Dealers and Manufacturers!

Have You Seen the

"DEPENDABLE"

Line of Radio Instruments and Complete Sets?

We manufacture a large line of **DEPENDABLE** apparatus—not the cheap mail order variety, yet our prices are low. Tuners, Couplers, Detectors, Fixed and Variable Condensers, Loading Coils, etc., also Binding Posts, Switch Points, Switch Levers, etc., etc.

Send for New Catalog No. 9

To our New York Office, 19 Park Place, New York City

DORON BROS. ELECTRICAL CO. Hamilton, Ohio

TEL. BACK BAY 5964

EASTERN RADIO INSTITUTE

RADIO

699 Boylston St. Boston - Mass

Our prospectus for the asking

Learn Wireless

Splendid opportunities now in the Merchant Marine. Big salaries. All graduates GUARANTEED good positions by one of the largest Wireless Telegraph Companies operating hundreds of ships to all parts of the world. REMEMBER: We are the OLDEST, LARGEST and BEST EQUIPPED school of its kind in New England, and have THOUSANDS of satisfied graduates to our credit. THIS SPEAKS FOR ITSELF. Day and Evening classes. Advanced classes in Radio Theory and code. Start any Monday.

on your desk telephone instrument, enables the small energy of your voice (about 1/6000 of a horse-power) to easily and perfectly modulate or control the tremendous amount of power produced by the Alexanderson alternator, or 270 horsepower.

AIRCRAFT RADIO.

Perhaps in no other single field are the advantages of the vacuum bulb transmitter and receiver more apparent than in aviation. The usual radio transmitting set had several disadvantages for aircraft radio where the open spark gap is used, which present a serious fire hazard, and also the ordinary crystal detector receiving set was almost worthless on board the airplane, for there was such a tremendous amount of noise present from the airplane engine that unless the signals received were exceedingly strong, they could not be heard by the pilot or radio officer.

Fig. 9 illustrates the applications of aircraft radio and shows how communication can be successfully and efficiently carried on from a shore station to balloons and airplanes, and also between two or more airplanes of a flying squadron or again as well as between airplanes and balloons. Radiotelephonic communication can be carried on both ways, without any fire hazard and with a minimum amount of power, thanks to the audion.

TRANSATLANTIC RADIO TELEPHONE.

Brief reference was made previously to the fact that several years ago the first trans-oceanic radiotelephonic messages were successfully transmitted and received, thanks to the audion, several hundred of which were connected on parallel, so as to form a veritable power plant at Arlington, Va. See Fig. 10.

There are several interesting developments now going on in this direction, which will undoubtedly bear fruit shortly. One of these lies in the development of large specially cooled high-power bulbs for generating radio or high-frequency energy, when high-voltage D.C. energy is applied to the plate and other members of the bulb. One of the principal advantages of audion transmitting sets, even in high-power units, lies in the fact that an ordinary microphone only is required to modulate or perfectly control the total output which may amount to 50 to 200 kilowatts.

THE AUDION DETECTOPHONE.

One could write an entire paper on the subject of the audion detectophone alone, if he was to even describe the applications of this most valuable instrument during the recent World War.

Telephone and telegraph messages were in some instances intercepted one mile back of the lines by a sensitive microphone, and these signals then amplified by a six, eight, or ten-stage audion amplifier, until they were clearly audible and readable by our intelligence officers.

Radio signals were in some cases picked up from far distant enemy stations, which altho in some cases of small size were of extreme strategic importance. See Fig. 11. Just to show how sensitive some of these measurements had become under the pressure of war, it may be mentioned that with a 10-stage audion amplifier in one of the college laboratories in New York City, radio signals were received with such powerful intensity, from the Nauen station in Germany, that they could be received on a loop-antenna six feet square, located in the basement and directional readings taken on this station, nearly 4,000 miles away, to within a fraction of a degree.

The French engineers developed some very excellent radio amplifying sets of surprising sensitivity and at a later date we hope to present some of the features of these sets in a special paper.

Your Future The demand for Radio operators both at sea and in land positions still persists. Better inducements are constantly offered. Our brief course equips you thoroughly for the best paying positions.

Terms moderate and payments arranged to suit your circumstances

SCHOLARSHIPS TO EX-SERVICE MEN

Call or write for descriptive literature.

Y. M. C. A. RADIO SCHOOL

Marcy Avenue near Broadway
BROOKLYN

Telephone Williamsburg 3800

B-BATTERIES

OUR "BETTER QUALITY" TYPE

22.5 VOLTS 15 CELLS

45 VOLTS 30 CELLS

We have decided to make our prices as low as possible regardless of the expensive materials which our "BETTER QUALITY" B-Batteries are made. Many wonder why we can make the price so low but it is because we live up to our motto "RETAILING AT WHOLESALE PRICES."

Cat. No.	Voltage	Average Life	Our Price	Post-paid Add
BB-154	22.5	4 months	$1.25	10c
BB-158	22.5	8 months	2.20	35c
BB-3012	45.	1 year	4.35	70c

We Guarantee each and every "Better Quality" B-Batteries on a money-back basis. No higher claims can be made more honestly. We can prove it.

FREE Our catalog of "BETTER QUALITY" Apparatus. Write now. Do not hesitate. Bargains such as audion cabinets complete $8.50. Red Seal batteries 38c, etc.

THE H. S. WIRELESS CO.
164 Ross St. Brooklyn, N. Y.

RADIO TELEPHONE & TELEGRAPH

Apparatus of Merit

Distributors for

DEFOREST
MURDOCK-AMRAD
MULTI-AUDI-FONE
PERFECTION

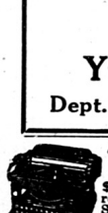
And Other Prominent Mfrs.

IMMEDIATE DELIVERIES

Send Stamp for Catalog

YOUNG & McCOMBS

Dept. 67 Rock Island, Ill.



TYPEWRITERS

$10 AND UP. ALL MAKES. SAVE $25 TO $50 on rebuilt at the factory by the well-known "YoungProcess." Sold for low cash—installment or rented. Rental applies on purchase price. Write for full details and guarantee. Free trial. YOUNG TYPEWRITER CO., Dept. 827 Chicago

The English radio experts developed a 19-stage audion amplifier, with which it became possible to hear buzzer signals being transmitted between German warships over 100 miles away; and the beauty of this marvelous amplification work is that there is practically no distortion or attenuation of the current or signals, whether they be telegraphic or telephonic.

A dot is a dot, and a dash is a dash, whether it is received and interpreted in the first stage or in the twelfth or nineteenth stage of the audion amplifier.

AN AUDION CLOCK OR CHRONOMETER.

As an illustration of a newly devised "audion clock," consider the system of Fig. 12-A which shows how a three-electrode tube may be used to maintain undamped oscillations of a pendulum.* Two sets of magnet coils are respectively inserted in the grid and plate circuits of the tube as indicated and placed in front of a small iron armature which is integral with the pendulum. As the pendulum is swung out of position, it oscillates back and forth, moving one end of the armature alternately toward and away from the grid coil. This induces an alternating potential between the grid and filament of the tube, which in turn varies the current in the plate circuit and plate coil. There results a correspondingly varying attraction of the coil on the opposite end of the armature which, for suitable magnitude of the currents and proper polarity of the connections has such a phase relation with respect to the oscillation cycle of the pendulum as to sustain its motion continuously. The energy expenditure from the plate battery is thus seen to compensate for the friction losses, which in the absence of the vacuum tube device would damp out the oscillations of the pendulum or bring it to rest.

A SYNCHRONOUS AUDION MOTOR.

A somewhat different case is that of Fig. 12-B which, however, is merely a different application of the same fundamental principle. The grid and plate coils are wound over iron cores having a gap in which is placed an iron disc which is free to rotate around the central axis. This disc is provided with a number of teeth. When set in motion, the teeth and slots of the disc alternately pass the iron core yoke of the grid coils, inducing an alternating grid E. M. F. which in turn synchronously varies the current in the plate coils. The attraction of the latter on the rotor teeth thus varies synchronously with the motion of the angular position of the two sets of coils around the disc and the proper polarity of the connections; these variations will occur at such times that the rotor is kept in continuous motion.

*See "Radio Engineering Principles," by Lauer and Brown, 1920. Pages 293-295.

OPPORTUNITIES FOR TECHNICAL GRADUATES.

Opportunities for technical graduates are very thoroly explained in an illustrated pamphlet bearing that title, recently issued by one of our largest electrical concerns in the country.

This booklet describes, in considerable detail, the plan which has been developed by this company for the training of the graduates of technical schools at all of its various works. In the booklet is included a list of prominent electrical men who originally entered the company as graduate students, as well as a complete list of schools from which over 5,000 students have entered the employ of the company.

Copies of the booklet will be sent to anyone interested on application thru the editor of this publication.

BOYS

Learn Drafting

Employers everywhere are looking for skilled draftsmen. They are offering good salaries to start with splendid chances for advancement.

Drafting offers exceptional opportunities to a young man because drafting itself not only commands good pay, but it is the first step toward success in Mechanical or Structural Engineering or Architecture. And drafting is just the kind of work a boy likes to do. There is an easy delightful way in which you can learn right at home in spare time. For 28 years the International Correspondence Schools have been giving boys just the training they need for success in Drafting and more than 200 other subjects. Thousands of boys have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon, then mark and mail it. This doesn't obligate you in the least and will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon now.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6219 SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

☐ MECHANICAL DRAFTING	☐ SALESMANSHIP
☐ STRUCTURAL DRAFTING	☐ ADVERTISING
☐ SHIP DRAFTING	☐ Show Card Writer
☐ ELECTRICAL DRAFTING	☐ Sign Painter
☐ ARCHITECTURAL DRAFTING	☐ ILLUSTRATING
☐ SHEET METAL DRAFTING	☐ Cartooning
☐ BOILERMAKER DRAFTING	☐ BUSINESS MANAGEMENT
☐ BRIDGE DRAFTING	☐ Private Secretary
☐ MACHINE DESIGN	☐ BOOKKEEPER
☐ ELECTRICAL ENGINEER	☐ Stenographer and Typist
☐ Electric Lighting and Railways	☐ Cert. Public Accountant
☐ Electric Wiring	☐ TRAFFIC MANAGER
☐ Telegraph Engineer	☐ Railway Accountant
☐ Telephone Work	☐ GOOD ENGLISH
☐ MECHANICAL ENGINEER	☐ Teacher
☐ Machine Shop Practice	☐ Common School Subjects
☐ Gas Engine Operating	☐ Mathematics
☐ CIVIL ENGINEER	☐ CIVIL SERVICE
☐ Surveying and Mapping	☐ Railway Mail Clerk
☐ STATIONARY ENGINEER	☐ AUTOMOBILE OPERAT'G
☐ Marine Engineer	☐ Auto Repairing
☐ ARCHITECT	☐ PLUMBING AND HEATING
☐ Contractor and Builder	☐ Textile Overseer or Supt.
☐ Concrete Builder	☐ Navigation ☐ Spanish
☐ Structural Engineer	☐ AGRICULTURE ☐ French
☐ CHEMIST	☐ Poultry Raising ☐ Italian

Name_____

Present Occupation_____ 7-25-19

Street and No._____

City_____ State_____

WANTED-Railway Mail Clerks

$1300 First Year

Hundreds Men—Boys—18 to 35 Needed

Paid Vacation Life Job.. Pull Unnecessary.

COUPON

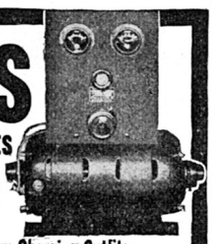
FRANKLIN INSTITUTE
Dept. O-101, Rochester, N.Y.

Sirs: Send me, without charge, (1) sample Railway Mail Clerk Examination questions; (2) schedule showing places of all U. S. Government coming examinations; (3) list of other government jobs now open; (4) free book describing them.

Name.....

Address.....

NEW MOTORS



FACTORY GUARANTEED - ALL SIZES - IN ORIGINAL BOXES

Your Opportunity To Buy New Guaranteed Electrical Apparatus of Standard Manufacture.

Single Phase Motors
110-220 volts, A. C., 60 cycle, 1800 R. P. M. with pulley

1/4	H. P., 110 volts, induction, full load start - -	$24.50
1/2	H. P., 110-220 volts, induction, full load start -	$38.50
1/2	H. P., 110-220 volts, repulsion, for compressor	$46.50
1	H. P., 110-220 volts, repulsion, with sliding base - -	$67.50
2	H. P., 110-220 volts, repulsion, sliding base	$108.50
3	H. P., 110-220 volts, repulsion, sliding base	$124.50
5	H. P., 110-220 volts, repulsion, sliding base	$164.50

Charging Generators
Suitable for all lighting Battery Charging and Power Requirements.

8 volts, 10 amp.	$16.50
15 volts, 10 amp.	$21.00
40 volts, 6 amp.	$24.50
110 v, 2½ amp.	$24.50
40 volts, 12 amp.	$38.50
110 volts, 5 amp.	$38.50
40 volts, 25 amp.	$58.50
110 volts, 10 amp.	$58.50
Moving Picture Arc Generator	$85.00

Polyphase Motors
2 and 3 phase, A.C., 220 v, 60 c, 1750 RPM., complete with base and pulley.

½ H. P. -	$42.50
1 H. P. -	$59.50
2 H. P. -	$72.50
3 H. P. -	$84.50
5 H. P. -	$102.50
1 H. P., high speed, 3600 R.P.M., 220 v 2 phase only -	$36.50

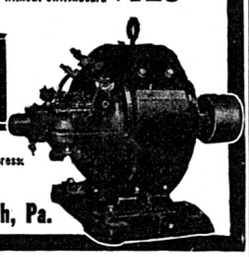
Battery Charging Outfits
To operate on A. C., 60 cycle, single phase voltage as specified.

110 volts, A. C., 100 watt. 24 volts, without switchboard	$40.00
110 volts, A.C., 150 watts, 30 volts, with switchboard	$68.50
110-220 volts, A. C., 250 watts, 24 volts, without switchboard -	$75.00
220 volts, A.C., 300 watts, 30 volts, without switchboard -	$85.00
110 volts, A.C., 375 watts, 36 volts, without switchboard -	$85.00
220 volts, A.C., 500 watts, 48 volts, with switchboard	$110.00
110 volts, A.C., 750 watts, 72 volts, without switchboard	$125.00

WRITE FOR CATALOG. BARGAINS IN MOTORS AND GENERATORS

SPECIAL **1/4 H.P.** 110 volts A.C., 60 c S.P., 1750 RPM. Complete, cord, plug & pulley

WASHING MACHINE MOTORS Suitable for operating Small Compressors, Coffee Grinders, Bottle Washers, Etc. **$19.75 EACH** Reg. Value $37.50



MONEY BACK GUARANTEE

SHIPPING TERMS: 25% deposit required on all orders. Balance C. O. D. by Express. Sight draft with Bill of Lading attached by freight.

MANUFACTURERS' DISTRIBUTER

CHAS. H. JOHNSTON, Box 12 West End, Pittsburgh, Pa.

Skinderviken Transmitter Button

is universal for making up Deaf-phones, Detecti-phones, Amplifiers, etc. Put a button on the outside of a window and listen to all that is said inside. Attach it to your Phonograph and transmit music, etc., to distant points. The best Transmitter for Local and Long Distance Telephone. Saves 75% Batteries. Super-sensitive. **Send me $1.00 for one Button with free descriptive booklet and circuit diagrams.**

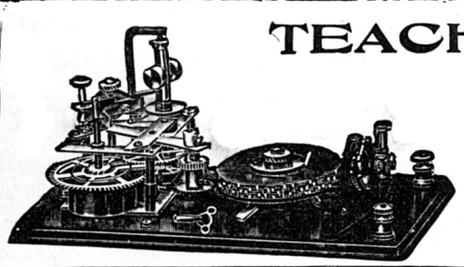
All kind of experimenters' supplies in stock. Receivers, induction coils, condensers, etc. Price list on request. Satisfaction guaranteed or money back.

J. SKINDERVIKEN
Inventor and Sole Manufacturer
335 Broadway, New York City, or 154 West Randolph Street, Chicago, Ill.

"THERE'S MONEY IN IT"

AT HOME **LEARN TELEGRAPHY** AT HOME
MORSE AND WIRELESS

TEACH YOURSELF



In half the usual time, at trifling cost, with the wonderful Automatic Transmitter. **THE OMNIGRAPH.** Sends unlimited Morse or Continental messages, at any speed, just as an expert operator would.

Adopted by U. S. Gov't. 4 styles. Catalogue free.

OMNIGRAPH MFG. CO.
39L Cortlandt St. New York

MODEL AIRPLANE SUPPLIES

Build and fly Model Airplanes

Send 5¢ for catalog of complete and knocked-down scale models of new machines, parts, fittings, and supplies.

Wading River Mfg. Co. 672 Broadway, Brooklyn, N.Y.

LEARN WIRELESS TELEGRAPHY

Fascinating and Educational Work—Big Salaries—Prepare Now

The United States Shipping Board is making heavy demands upon us for **Dodge-trained** wireless operators. Travel all over the world, secure, free, unsurpassed living accommodations and earn a big salary.

We Also Teach Morse (Wire) Telegraphy and Railway Accounting

School established 45 years. Endorsed by wireless, railway and telegraph officials. Low rates. Students can earn living expenses while attending school. **Catalog Free. Write Today.**

Dodge's Telegraph and Wireless Institute 22 nd St., Valparaiso, Indiana

Vacuum Tube Circuits

By PIERRE H. FOUCHERON, Ensign, U.S.N.R.F.

(*Continued from page* 1028)

perhaps interesting to note that regenerative amplification differs from "cascade" amplification (see Fig. 10) in that the original grid potential is not past on to the grid circuit of a second or third tube, but is actually transferred to the grid circuit of the initial tube, where it again passes thru to the plate circuit, but this time greatly amplified owing to the inherent amplifying properties of the VT, thereby causing a much greater response in the telephones. All parts of Circuit No. 6 are essentially the same as any detector circuit with the addition of the coupling L1 and L2, sometimes termed the "feed back" or "tickler." This coupler may easily be constructed by winding a number of turns of No. 22 or 24 insulated copper wire on card-board tubes three or four inches in diameter, and by so arranging them that the degree of their coupling may be varied at will. With this circuit it is possible to receive either *damped* or *undamped* signals; the first by loosening the coupling to such a point that no oscillations will be set up in the secondary coil (L1); the second, by increasing the coupling to the point where sustained oscillations are set up in the secondary circuit. In the latter case, a musical note of any desired pitch will be heard in the telephones depending upon the degree of *detuning*.

NO. 7—COMBINATION "VT" AND CRYSTAL AMPLIFIER.

If the experimenter possesses but one VT and yet wishes to experiment in *damped wave amplification,* circuit No. 7 may be employed with considerable success. The VT circuit is the same as circuit No. 4, with the exception that in the place of the telephones is inserted the primary of the coupling transformer C. T., the secondary of which is connected to the crystal and telephones in the manner shown. The condenser shown in the detector circuit may be shunted directly across the telephones and in its present place a variable condenser substituted enabling this oscillating circuit to be tuned to the frequency of the incoming waves. The ground variable condenser G. V. C. is optional and is not absolutely essential in this case. The transformer referred to is one specially designed for radio frequencies. If this is not obtainable, use may be made of a grafite rod of a half megohm or so. A signal amplification of 100 times or more may be obtained with this hook-up.

NO. 8—EFFECTIVE DAMPED-UNDAMPED "VT" CIRCUIT.

This circuit is extremely sensitive, reliable and simple and has been used considerably by the Navy. It will receive *damped, undamped* or *radiophone* signals quite satisfactorily, and on account of its few parts and adjustments is especially recommended to the amateur. There is but *one* variable antenna inductance, which is much easier to construct than the usual loose-coupler. The tickler coil inductance should be such that its natural period will not come within the wavelength of the receiver; a fact which can soon be ascertained by experimenting with individual conditions at hand. As may be noted, the action that takes place in this circuit is similar to the Regenerative circuit of Fig. 6, and either damped or undamped signals are received in a like manner of procedure.

RADIO APPARATUS
Raw Material and Parts

Distributors of All Prominent Makes. Largest and Best Stock of Any House in New England.

These switches, jacks and plugs are Navy standard equipment in Receiving sets, Amplifiers, Audion control boxes and in all wireless apparatus. Experimenters should avail themselves of this high grade material.

Federal No. 1424-W—D. P. D. T. 12 spring Anti-capacity switch .....$2.50 ea.
Federal No. 1426-W—D. P. S. T. 4 spring Anti-capacity switch .....$2.25 ea.
Federal No. 1427-W—D. P. S. T. 4 spring Anti-capacity switch .....$2.35 ea.
Note—The contacts on the No. 1424-W and No. 1427-W are "Normally open" while on No. 1426-W they are "Normally closed."
Federal No. 1421-W—Open circuit jack .55 ea.
Federal No. 1422-W—Closed circuit jack .65 ea.
Federal No. 1423-W—Two circuit jack....90 ea.
Federal No. 1428-W—Brass plug....$1.50 ea.
Federal No. 1428-W—Silver-plated plug, $1.75 ea.
Federal No. 226-W—Type A, Audio-frequency amplifying transformer $7.10
(All postpaid to any part of the U. S.)
All orders shipped the same day. Give us a trial.
Send six cents in stamps for our new catalog just out! Every amateur should have it.

F. D. PITTS CO., Inc.
12 Park Sq. Dept. D. Boston, Mass.

BURGESS "B" BATTERIES

These batteries proved so successful in Government Apparatus that they are being used by progressive amateurs. Made in three sizes and now available for general use. For full information write to

BURGESS BATTERY COMPANY
Harris Trust Bldg. -:- Chicago

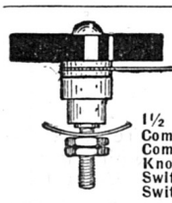
WIRELESS AMATEURS

Send a 2c. stamp for full description of

The Barr Mercury-Cup Detector

the most efficient detector in the wireless field-today.
Tested by Marconi Wireless Telegraph Co. and U. S. Government.
Increases the efficiency of every wireless receiving set by making the signals clear, sharp and distinct. Instantly adjustable at a constant pressure.

THE BARR MERCURY-CUP DETECTOR
Dept. A, The Wyoming, Washington, D. C.



WILCOX PANEL SWITCH
"The Best"

1½ In. Radius	Postpaid Price
Complete Switch, polished brass finish	50c
Complete Switch, nickel plated finish	60c
Knob, turned and polished	25c
Switch points, brass finish	2c
Switch points, nickel plated finish	4c

THE WILCOX LABORATORIES, Lansing, Mich.

MEMORIZE WIRELESS CODE ALMOST INSTANTLY

My method is the short cut. Complete chart and full instructions, 10 cents, coin or red stamps.

C. K. DODGE
Box 100 Mamaroneck, N. Y.

Broadly speaking, damped signals (spark) range from 200 to 5,000 meters, while undamped signals (arc or alternator) may range from 5,000 to 20,000 meters, tho, of course, there are some few exceptions to this. Sufficient antenna and tickler inductance must therefore be chosen to meet the desired wavelengths.

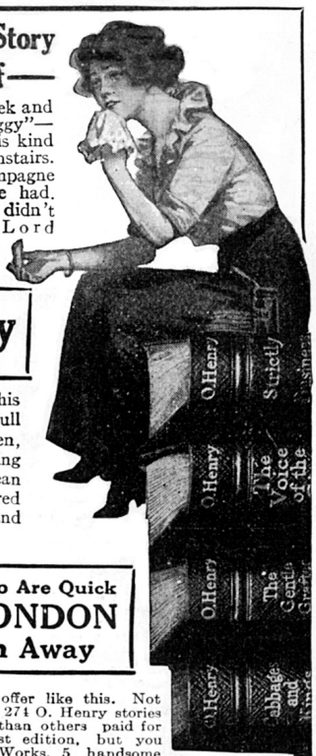
NO. 9—NAVY TYPE TWO-STAGE AMPLIFIER.

This circuit is quite within the province of the up-to-date amateur and can be constructed in compact form similar to the amplifiers used by the Army and Navy which are enclosed in convenient and portable cabinets. It will be noted that the two *audio frequency* transformers T1 and T2 are arranged so that their inductance will be at right angles to each other *in order to eliminate any possible mutual relation* which would cause undesirable operating conditions. The make-up of each of these *air core* amplifying transformers usually consists of 8 sections, the inside diameter of which is about 2 inches and the outside diameter about 2¾ inches. There should be six secondary sections, each one wound with 6,000 feet of No. 40 enameled copper wire and all connected in series, and there should be two primary sections, each one wound with 3,000 feet of No. 40 enameled wire, also connected in series. The primary and secondary sections should be arranged on an insulated air core about 2½ inches long, side by side, in the following sequence: Two sections of SECONDARY, one section of PRIMARY, two sections of SECONDARY, one section of PRIMARY and again two sections of SECONDARY. It is more convenient, however, to purchase these outright. *Radio frequency* transformers may be employed instead. Both types sometimes have a laminated *soft iron core.* Experimenters should bear in mind that there are two general methods of amplification, both of which are used extensively; i. e., radio frequency amplification (above 10,000 cycles) and audio frequency amplification (below 10,000 cycles). In circuit No. 9, the usual receiver and detector system, not shown in cut, is connected from the point where the telephones would ordinarily be placed, to the two connections marked "Input". The common "A" and the common "B" batteries furnish the necessary current for the filaments and for the plates of the two tubes, respectively, and altho the plate voltage in this case is shown to be 20 to 40 volts, experimenting will decide the voltage best adapted to the individual tube. The telephones are fitted with a plug which in turn may be plugged in any one of the telephone jacks marked "Detector," "Step 1," and "Step 2" as desired.

NO. 10—AMATEUR CASCADE AMPLIFIER CIRCUIT (DAMPED WAVES).

It necessitates three tubes, but as will be noted from circuit diagram, it employs only one common "A" and one common "B" battery, which is in itself a great economy. The "A" battery should be either 4 or 6 volts, according to what the particular tubes require and should be of the storage battery type, altho dry cells may be used instead for short intervals. The "B" battery should be from 40 to 80 volts, the proper voltage also depending on the type bulb used. Most tubes are sold with instructions giving the necessary data. Variable condensers V.C. are of standard .005 mfd capacity. The three leak resistances R1, R2, R3, as well as the coupling resistance R4, are grafite rods of two megohms each, and can be purchased at any grafite or radio supply house. The "choke" shown in the circuit can be made by winding 10,000 turns or so of No. 36 enameled copper wire on a metal core made up of small iron wires ⅝ of an inch in diameter and about 3 inches in length. The grid condenser G.C., of course, is the standard fixt type, .0001 mfd capacity, while the coupling condensers C1 and C2 are prefer-

Finish This Story For Yourself—



The girl got $6 a week and was lonely. "Piggy"—you can imagine his kind—was waiting downstairs. He knew where champagne and music could be had. But that night she didn't go. That was Lord Kitchener's doing. But another night?

O. Henry
(12 Volumes)

tells about it in this story, with that full knowledge of women, with that frank facing of sex, and that clean mind that has endeared him to the men and women of the land.

To Those Who Are Quick
JACK LONDON
5 Vols. Given Away

Never was there an offer like this. Not only do you get your 274 O. Henry stories in 12 volumes at less than others paid for one volume of the first edition, but you get Jack London's Works, 5 handsome volumes—without paying a cent. You get 17 volumes, packed with love and laughter—a big shelf full of handsome books.

SHIPPED ON APPROVAL

We will ship the two complete sets so that you can look them over in your home and then decide whether or not you wish to buy. If you are not delighted with O. Henry and the free Jack London notify us and we will take the sets back as cheerfully as we sent them. How could any proposition be more fair?

INSPECTION COUPON

THE RIVERSIDE PUBLISHING CO., (2-20)
140 So. Dearborn St., Chicago, Ill.

Please ship me on approval the Works of O. Henry, 12 volumes, new Fabrikoid binding, gold tops. Also the 5 volumes set of Jack London bound in silk cloth. If I keep the books I will pay you $1.00 as first payment within 10 days after books are received and $3.00 per month until your special price of $29.00 for the O. Henry set only is paid, and it is agreed I am to retain the Jack London set without charge. If not satisfactory I will notify you within 10 days and return both sets to you as soon as you give me shipping instructions as offered readers of Electrical Experimenter.

Name.....
Address.....
Business or Employer.....

Ridpath's History of the World
AT A BARGAIN

Nine Big Vols. 4000 Pages 2000 Pictures

On account of the great increase in cost of paper and leather it is necessary to soon increase the price to cover increased cost of manufacture. We will name our present low price and easy terms only in direct letters to those mailing us the Coupon below. Tear off Coupon, write name and address plainly, and mail now before you forget it. The 32 Free Sample Pages will give you some idea of the splendid illustrations and wonderfully beautiful style in which the work is written. Thousands have already availed themselves of our offer and every purchaser is more than satisfied.

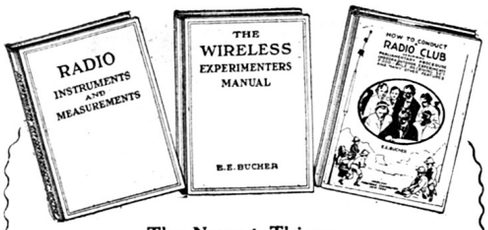
MAIL COUPON NOW.

FREE COUPON

WESTERN NEWSPAPER ASSOCIATION, (2-20)
140 So. Dearborn St., Chicago, Ill.

Please mail your 32-page free sample booklet of Ridpath's History of the World, containing photogravures of Napoleon, Socrates, Cæsar and other great characters in history, and write me full particulars of your special offer to Electrical Experimenter readers.

NAME .....
ADDRESS .....



The Newest Things
IN WIRELESS
Are in These Three Books
Just Off The Press

RADIO INSTRUMENTS AND MEASUREMENTS
Every amateur should have this book as it answers the questions you want to ask and covers all phases of the subject matter indicated by its title.
Cloth Bound, 320 Pages. Price $1.25

THE WIRELESS EXPERIMENTERS' MANUAL
By E. E. Bucher
Mr. Bucher's latest book. The only one that comprehensively covers all phases of wireless work, including the latest practices in both Radio Telegraphy and Telephony. Most complete text book on these subjects yet published.
Cloth Bound, Approximately 300 Pages. Price $1.75

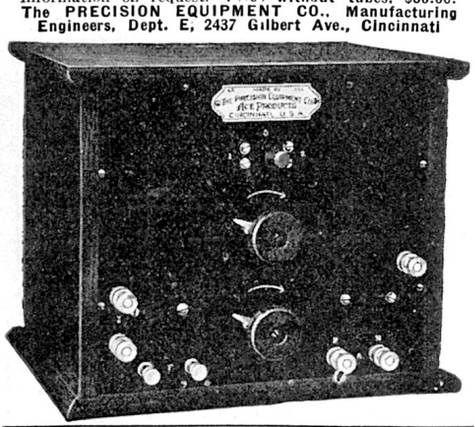
HOW TO CONDUCT A RADIO CLUB
By E. E. Bucher
One of the most popular wireless books ever published. Covers parliamentary procedure, indoor and outdoor experiments, 5,000-mile receiving sets, use of vacuum tubes and many other subjects.
Paper Cover, 148 Pages. Price 50c

THE WIRELESS AGE
A monthly magazine that will keep you posted on the up-to-the-minute things in wireless communication. Official organ of the National Amateur Wireless Association.
Price Per Year $2.00

SPECIAL COMBINATION PRICE
All Four for Only $4.50

WIRELESS PRESS
1850 Woolworth Building, New York

ARE YOU SATISFIED--
with a double-slide tuner, crystal detector, and 80-ohm phones?
If you are, don't waste your time reading this—but if you want to get the maximum range from your set, we have the instruments that will give you this range at all times. Our instruments are real professional quality.
The two step amplifier illustrated, will give the maximum amplification and has "B" Batteries included. It uses standard V. T. Tubes. Further information on request. Price without tubes, $50.00.
The PRECISION EQUIPMENT CO., Manufacturing Engineers, Dept. E, 2437 Gilbert Ave., Cincinnati



"The Livest Catalog in America"
Our big, new electrical cyclopedia No. 20 is waiting for you. Positively the most complete Wireless and electrical catalog in print today. 180 Big Pages, 500 illustrations, 300 instruments and apparatus, etc. Big "Treatise on Wireless Telegraphy." 20 FREE coupons for our 160-page FREE Wireless Course in 20 lessons. FREE Cyclopedia No. 20 measures 7x5¼". Weight ½ lb. Beautiful stiff covers.

WIRELESS

Send 6 cents in stamps or coin for which we will send our latest Cyclopedia Catalog No. 20 as described.

ELECTRO IMPORTING COMPANY
231 Fulton St., New York City

35 Miles per hour
Is Record of this Car

Boys, Build This Car. This nift little car driven by gasoline motor, can be built by any boy. Parts are furnished by us and are very cheap. Send 26c for building plans and price list of parts showing how to build this lad's car.

SYPHER MFG. CO.
156 Warren Street
TOLEDO, OHIO.

ably .005 mfd each, either fixt or variable. tho the first is the least expensive. The head telephones P should have a combined series resistance of 3,000 ohms. All connections to and from the various instruments should be as short as possible, well insulated and devoid of surrounding undesirable induction. Run all wires at right angles to avoid "howling" effects.

Experiment with this circuit. Try lead pencil line grid leaks of different sizes. Increase or decrease the potential of the "A" and "B" batteries.

NO. 11—VT TELEGRAPH TRANSMITTING CIRCUIT.

There are many complicated circuits capable of undamped wave generation, but one of the most simple ones is shown here. Briefly speaking, all that is required to produce undamped waves suitable for transmission, is that it is necessary to couple the plate and grid circuits of the VT to a common oscillatory circuit (in this case, the antenna circuit), and in such a manner that the resulting grid-to-plate coupling will be of negative potential. In this circuit, L2 and L3 are variable in their coupling of the common oscillatory circuit L1. The antenna circuit, however, must have a natural wave length at least equal to that of the oscillations produced by the VT.

This circuit will not be effective if the antenna has too large a radiating capacity and therefore experiments of this nature must be carried out on small antennæ of 200 meters or less, and for very short distances of less than a mile. Better results can be secured by using a regular transmitting tube capable of operating at high plate potential such as 400 or 500 volts. Several receiving VT's may also be connected in parallel, but the plate voltage must be confined to a potential not greatly exceeding 100 volts, otherwise undesirable "blue glow" of the bulbs will result.

No. 12—A VT RADIOPHONE TRANSMITTING CIRCUIT.

This circuit, known as the direct current modulation control, does not involve complicated apparatus and has been used successfully by up-to-date amateurs over considerable distances, when using three or more tubes in parallel instead of one as shown here. The principle of this method is to impress upon the grid G, a constantly changing potential by speaking in the telephone transmitter T, which in turn changes the internal plate resistance of the tube. Thus the plate current is transformed into high frequency oscillations, which in turn are modulated by the characteristics of the voice.

The following explains the various parts of the circuit: T is an ordinary telephone transmitter; C is a 4-volt battery; T.T. is a small telephone transformer; K is an iron wire core "choke" of large inductance, but small ohmic resistance; B is the high potential plate battery; A is the low potential filament battery; R is a grid leak resistance of 1 or 2 megohms; G.C. is a grid condenser; L the variable antenna inductance and V.C. the aerial-ground variable condenser which couples the plate to the system.

In the various receiving circuit diagrams shown in various publications there seems to have been no set rule concerning the "A" and "B" battery polarity connections, and this fact often perplexes some experimenters. In this connection, prolonged tests by experts has establisht the fact that there is no great difference in the manner in which the negative side of the high potential "B" battery is connected to either the negative or positive side of the filament current "A" battery. For the purpose of simplicity most government diagrams prefer a connection from the negative side of the "B" battery to the negative side of the "A" battery, while many De Forest circuits show a negative to positive connection. Try both ways.

COPPER AERIAL WIRE
100 FEET FOR 50c.

We still have some No. 14 pure copper aerial wire which we are closing out at 2 feet for one cent. All orders must be accompanied with sufficient postage and insurance charges or they will be shipped by express collect. Prices subject to change without notice.

Our stock is constantly expanding and including many new items at our cut prices. We offer a few items below. Be sure and include postage and insurance on each of these items or we shall be forced to ship by express collect which will cost you much more than if the goods were shipped by parcel post.

Carbon Grain Transmitters—Two types, one of high amperage and suited for wireless telephone transmission, the other type designed to operate on two dry cells. Shipping weight, 2 lbs. Price $1.00.

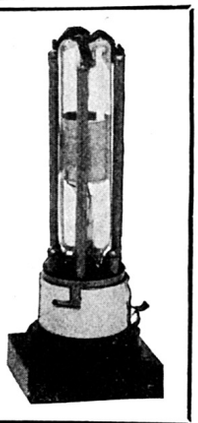
Binding Posts, Brass Nickel-Plated—Shipping weight per dozen, 1 lb. per doz., $.30.

Hard Rubber Knobs—Small size, per doz., $.30.
Induction Coils—Primary 1 ohm-secondary 55 ohms, shipping weight, 1 lb. Each, $.50.

Small Complete Telephones equipped with induction coil, switchook, transmitter, receiver, mouthpiece and binding posts ready to mount on your wall—no signalling equipment included. These telephones operate on two dry-cells, shipping weight, 5 lbs. Each, $3.00.

Send 5c for our illustrated catalogue

ELECTRICAL SPECIALTY CO.—Dept. E
48 So. Front St. Columbus, Ohio



The ORIGINAL AUDIOTRON ADAPTOR
Consists of a standard 4 prong base with appropriately placed brass pillars to accommodate five leads. Practical and convenient.
$1.75 EACH Postpaid
Pat. Applied For

New "VT" Socket, $1.00 Postpaid

One look convinces you our **Paragon Filament Rheostat** is the best. The 6 ohm non-oxidizing resistance, permits fine adjustment on 4 or 6 volts. Cast in heat-proof Condensite 2¼" dia. for back or front mounting.
$1.75 Each, Postpaid

Have you found out yet that block batteries are impractical and rather costly for 'trons?
Our 45-volt VARIABLE "B" BATTERY complete, in wooden case with set of jiffy connectors at the price of a 22½-volt block battery. **$3.50,** plus postage.

NEW CONSOLIDATED RADIO CALL BOOK (2nd) $1.00 EACH

RADIO EQUIPMENT CO.
630 WASHINGTON ST. BOSTON, MASS.

SELENIUM CELLS
Made by entirely new process. Highly sensitive and quick-acting. Suitable for all experiments. From $5 up.
Write for Catalog
Selenium Laboratories
Good Ground, Long Island, N. Y.

Universal Radio System
Up to the minute radio apparatus for progressive users who can recognize quality.
Send stamp for catalogue.
Universal Radio Mfg. Corp.
Dept. W Elmira, N. Y.

CATALOG H
Send 5c in stamps for your copy today and get on mailing list for future bulletins without charge. Contains 24 pages of reliable apparatus, standardized parts and raw materials. Complete line switch points, knobs, switches, rod, aerial wire, etc.
SHOTTON RADIO MFG. COMPANY, P. O. Box 3, Scranton, Pa
Branch: 8 Kingsbury St., Jamestown, N. J.

BOYS! Make Things AT HOME

1. The Study of Electricity for Beginners.
2. Dry Batteries. How to Make Them.
3. Electrical Circuits and Diagrams. Part 1.
4. Electric Bells, Annunciators and Alarms.
5. Modern Primary Batteries.
6. Experimenting with Induction Coils.
7. Electric Gas Igniting Apparatus.
8. Small Accumulators. How to Make and Use.
9. Model Steam Engine Design.
10. Practical Electrics.
11. Inventions. How to Protect and Sell Them.
12. Woodwork Joints. How to Make and Use.
13. The Fireman's Guide to the Care of Boilers.
14. The Slide Valve Simply Explained.
15. The Magneto Telephone.
16. The Corliss Engine and Its Management.
17. Making Wireless Outfits.
18. Wireless Telephone Construction.
19. The Wimshurst Machine. How to Make It.
20. Simple Experiments in Static Electricity.
21. Small Electrical Measuring Instruments.
22. Electrical Circuits and Diagrams. Part 2.
23. Induction Coils. How to Make Them.
24. Model Vaudeville Theatres.
25. Alternating Currents. Simply Explained.
26. How to Build a 20-Foot Bi-plane Glider.
27. A B C of the Steam Engine.
28. Simple Soldering. Hard and Soft.
29. Telegraphy for Beginners.
30. Low Voltage Lighting with Storage Batteries.
31. Lieckfeld Gas and Oil Engines.
33. House Wiring for Electric Light.
34. Magnets and Magnetism.
36. Small Windmills and How to Make Them.
37. Collin's Wireless Plans. Part 1.
38. Collin's Wireless Plans. Part 2.

Price 35 cents each, postpaid

SPON & CHAMBERLAIN
120 G Liberty Street, New York

3-INCH DIAL INDICATOR

Black Composition with Brilliant White Filled Engraving

Dial No. 66 only postpaid $.75

Dial No. 67 with Bakelite Knob, postpaid, $1.30.

For Sale By All RADISCO Agencies and by

A. H. CORWIN & CO.
4 West Park St., Newark, N. J.

Electrical men with training are in demand. For more than a quarter of a century, this school has been training men of ambition and limited time, for the electrical industries. Condensed course in Electrical

Engineering enables graduates to secure good positions and promotions. Theoretical and Practical Electricity. Mathematics, Steam and Gas Engines and Mechanical Drawing. Students construct dynamos, install wiring and test electrical machinery. Course with diploma complete

In One Year

Over 3000 men trained. Thoroughly equipped fireproof dormitories, dining hall, laboratories, shops.
Free catalog. 28th year opens Sept. 29, 1920

BLISS ELECTRICAL SCHOOL
260 TAKOMA AVENUE, WASHINGTON, D. C.

SEND TO-DAY

For Catalog for Complete Line of

Receiving Apparatus

REMLER RADIO MFG. CO.
163 Sutter St. San Francisco, Calif.

FREE We are giving away hundreds of expensive wireless instruments, electrical apparatus, supplies, etc., for selling a household article that goes like wildfire because it is a genuine necessity and because it sells so cheap. All of our premiums are guaranteed new and perfect. We give you no junk. Send us your name and address and we will send you twelve articles prepaid complete information and premium catalogue
L. Beck Novelty House, 1298 Carroll St., Brooklyn, N. Y.

Reversible Airplane Propellers

(*Continued from page* 1002)

the horsepower, design of the wing and speed of the plane. Therefore, it must include the gliding factor of any plane however designed. For instance, if a plane has a high gliding factor, a reversible propeller may show good results. On the contrary, if the gliding factor of a plane is low, a reversible propeller would be positively dangerous because a plane with a low gliding factor, if it was stopt down to a speed which would still further lower its gliding factor, the result would be unquestionably a serious crash, endangering, if not causing, the end of the pilot's life. From a practical point of view, the propeller could best be used immediately upon the plane touching its landing place, but hardly before.

When a plane leaves the ground a low-pitch propeller could quickly make it rise from its position. If, then, the propeller could be used for the purpose of increasing its pitch, it would gradually gather speed and quickly reach a reasonably high "ceiling." After a ceiling has been reached which showed the maximum altitude of the plane with the propeller at a certain pitch, if this propeller could be increased in pitch the plane would make further progress in altitude and results would indicate such procedure as being both practical and successful.

It is difficult, of course, to give an intelligent opinion on the subject of reversible propellers such as used at McCook Field, Dayton, Ohio, unless the full facts were well known. These facts, of course, are more or less not in evidence from the description of this device given in the daily press.

The principle involved, of course, is interesting and may be practically operable. If so, we have made quite a decided advance in aeronautics, and I sincerely hope that this principle has been practically worked out and will continue to improve in value.

Tokio has about 45,000 telephones and 60,000 persons are said to be seeking the service.

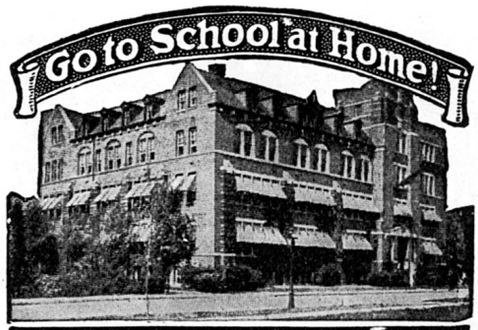
More small towns in Norway use electricity than in any other country, owing to the abundance of water power.

Hitting Invisible Targets

(*Continued from page* 1003)

at least two methods of nullifying the effect of any counter attack shell-fire from the enemy battle-fleet, so far as this advanced ship is concerned, and these are to wit: First the scout ship may be a very fast vessel, perhaps on the order of Doctor Alexander Graham Bell's new sea-going speed ship which can make 70 miles an hour and better, and which, when properly camouflaged, would present a very difficult target to hit. Secondly,—and if the attacking fleet is one of Uncle Sam's or one of a British fleet, let us say, we can take a chance of being mist by the inferior gunfire of the enemy. And then we have smoke barrages to hide the ship, etc., etc.

The seaplane of course provided a very excellent scout for any such battle maneuver as this and while it has practically nothing to fear from anti-aircraft guns at such a distance as would probably intervene, it still has one worry,—counter-attack by an enemy airplane which might engage it in aerial combat. Thus, we see that so far we have discovered two ways in which to



HIGH SCHOOL COURSE IN TWO YEARS

YOU ARE BADLY HANDICAPPED if you lack High School training. You cannot attain business or social prominence. You are barred from a successful business career, from the leading professions, from well-paid civil service jobs, from teaching and college entrance. In fact, employers of practically all worth-while positions demand High School training. You can't hope to succeed in the face of this handicap. But you can remove it. Let the American School help you.

FIT YOURSELF FOR A BIG FUTURE This Course, which has been prepared by some of America's leading professors, will broaden your mind, and make you keen, alert and capable. It is complete, simplified and up-to-date. It covers all subjects given in a resident school and *meets all requirements* of a High School training. From the first lesson to the last you are carefully examined and coached.

USE SPARE TIME ONLY

Most people *idle* away *fifty* hours a week. Probably you do. Use only one-fifth of your wasted hours for study and you can remove your present handicap within *two years*. You will enjoy the lessons and the knowledge you will gain will well repay the time spent in study.

TAKE 10 LESSONS FREE So that you may see for yourself how thorough and complete our training is. We invite you to take *ten lessons* in the High School Course—or any Course of specialized training in the Coupon below—before deciding whether you wish to continue. If you are not then satisfied you are not out one cent. *We absolutely guarantee satisfaction.* On that basis you owe it to yourself to make this test. Check and mail the coupon NOW for full particulars and Free Bulletin.

AMERICAN SCHOOL
OF CORRESPONDENCE
Dept. H. 262. Chicago, Illinois

TRAINING—THE KEY TO SUCCESS

Please explain how I can qualify for the position marked X

.....High School Graduate	.....Lawyer
.....Electrical Engineer	.....Business Manager
.....Elec. Light & Power Supt.	.....Certified Pub. Accountant
.....Hydroelectric Engineer	.....Accountant and Auditor
.....Telephone Engineer	.....Bookkeeper
.....Telegraph Engineer	.....Stenographer
.....Wireless Operator	.....Fire Insurance Expert
.....Architect	.....Sanitary Engineer
.....Building Contractor	.....Master Plumber
.....Civil Engineer	.....Heating and Vent. Engineer
.....Structural Engineer	.....Automobile Engineer
.....Mechanical Engineer	.....Automobile Repairman
.....Shop Superintendent	.....Airplane Mechanic
.....Steam Engineer	.....General Education Course
.....Draftsman and Designer	.....Common School Branches

Voice Thrower 10c

Learn to throw your voice into a TRUNK, under the bed, out in the hall or anywhere. Lots of FUN fooling the Teacher, Janitor, Policeman, Parents, Neighbors, or Friends.

THE VENTRILO

is a little instrument that fits into the mouth out of sight. BOYS or GIRLS can use it in conjunction with the above for imitating birdsand animals. Never fails. A 32-page book on Ventriloquism sent with the Ventrilo for 10 cents.

NEW FORD JOKE BOOK 1920

All the latest jokes on the Ford auto. Hundreds of them, and all good ones. Spring a new one on your neighbors.

Large book with cover by mail, 10c

ROGEN X-RAY

Price 12 cents

HERE, BOYS, is just what you want. With this instrument you can apparently see the bones in your fingers. Think of the fun you can have with it. Sample by mail, **TWELVE CENTS.**

SKULL RING

Here is a handsome, up-to-date Ring, representing a Skull and Cross-bones. Has stones in the eyes and looks something frightful. Women won't like it, but for men or boys it is a great novelty. **Sample, by mail, 15c.**

Gee! What a Wad!

This is STAGE MONEY

Looks like the GENUINE STUFF. Some Green backs and some Yellow backs. Create a BIG sensation among your friends. The girls will all be after you when they see the wad. BIG roll of 15 pieces by mail, **10 cents.**

ENCHANTED BARREL

The Most Wonderful Pocket Trick Made

CHANGE A CENT INTO A DIME

Ask your friend to drop a dime in the barrel. When he takes it out, Behold! It is a CENT. You make 9 cents every time you fool them. Never fails. They cannot get on to it. Sample barrel, with directions, only.... **12c**

Hindoo Flower Pot Trick

You have all heard of the great Hindoo trick (making a plant grow out of a flower pot right in front of an audience). This trick has puzzled the whole world for years until an old Hindoo fakir gave it away. We send the whole outfit by mail with full instructions for **15 cents.**

BIG VALUE for 10 Cts.

6 Songs, words and music; 25 Pictures Pretty Girls; 40 Ways to Make Money; 1 Magic Book; 1 Book Letter Writing; 1 Dream Book and Fortune Teller; 1 Cook Book; 1 Baseball Book, giving rules for games; 1 Toy Maker Book; Language of Flowers; 1 Morse Telegraph Alphabet; 12 Chemical Experiments; Magic Age Table; Great North Pole Game; 100 Conundrums; 5 Puzzles; 12 Games; 30 Verses for Autograph Albums. **All the above by mail for 10c.**

Trumpet in Handkerchief

The Trumpet in the Handkerchief has come to torment us. It is a startler. A small metal trumpet is ingeniously concealed in a handkerchief. On meeting your friends, after chatting awhile, you take out this handkerchief and blow your nose. It's like a sudden clap of thunder! The ladies scream, and your male friends will think they heard the whistle of a steam engine. You can blame the hideous noise to your having a very bad cold, and keep the fun up as long as you like. **Price 10c, 3 for 25 cents, by mail.**

ALLEN OUTLAWS

A new illustrated book in 42 chapters. Tells the provocation that led up to the most daring gun fight on record, where they shoot the Judge Sheriff, States attorney, 3 Jurors, and 8 others in the Hillsville Court Room. All crimes have a woman back of it, and BOYS, this one is worth reading. Large bound book inplain wrapper for **TEN Cents.**

Any of the above Mailed with Catalog

ROYAL NOVELTY COMPANY

416 East Ave., South Norwalk, Conn.

fire at an enemy target with accuracy, at least after firing a few ranging shots at the start of the engagement, i.e., by using a fast scout ship or else a seaplane. A third scheme, which is used by land batteries, such as coast defense guns and fortifications, for firing at an invisible target, such as a war vessel beyond the horizon, is to have the water between the battery and the fort laid off in squares and to plot these squares accurately on special maps. With this arrangement, the guns of the battery can be trained to drop shells in any square desired, even those out of sight, the gunner never seeing the target in any case, but firing literally and figuratively, solely by mathematics, into the blue sky.

The position of the enemy vessel in a certain numbered square is all the information that is required, and there are several ways in which this information may be obtained today. They might get this information from fast scout vessels, such as torpedo boat destroyers or submarine chasers, lying just out of sight of the approaching enemy war vessels, but over the horizon, and whose information would be radioed to the fort.

Another way would be to spot the locations of the enemy vessels either from an air or seaplane or observing balloon, flying over the fort, while still another manner of ascertaining this valuable information would be to employ one of the newly devised under-water sound listening methods, which were very highly perfected during the war for locating the direction in which the ship lies, by the sound given off thru the water by its propellers, and as a further afterthought would it not be possible, at least in an emergency, to use the airwave sound ranging device described in Colonel Trowbridge's article, which appeared in the December issue, in the event of course, that the enemy had opened fire on some outlying vessels or other fortifications, so that the gun bursts could be accurately timed and located. It should not be forgotten also that the sound-ranging methods used by the A. E. F. in France, with such great success, could be used in this case for locating the position of the "bursts" of the friendly shellfire so that if the exact position of the enemy target was known to the battery commander, he could locate by *sound-ranging*, the exact distance to the right or left, as to where the shell were bursting in the vicinity of the target.

Radio Telephony and the Airplane

By WILLIAM C. MUNDT

(*Continued from page* 1030)

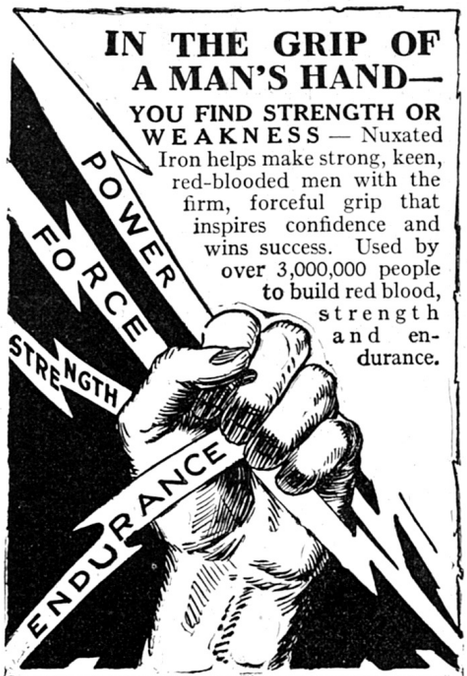
this type was used only on receiving planes. The directional effect would have been the same even with 200-foot trailers and the capacity has been taken care of in the double-W of the antenna, which was seven-stranded No. 20 antenna wire, while the trailers are of single stranded bare copper.

Whenever a plane landed it was the duty of the "Line Radio Mechanic," who carried a reel of No. 20 wire, to at once wind up the trailers on the lower wing, thereby checking the length of the antenna. Fourteen turns was the necessary amount for the trailing type and three and a half turns for the "double-W" type. If there was less he at once added enough to make up the loss.

When the planes were ready to take off, the trailers were unwound and laid out on the ground. A condenser of 2 microfarads was placed in series with antenna leads in the transmitting ship to prevent a short circuit thru the set, should the trailing wires touch any part of the plane while

IN THE GRIP OF A MAN'S HAND—

YOU FIND STRENGTH OR WEAKNESS — Nuxated Iron helps make strong, keen, red-blooded men with the firm, forceful grip that inspires confidence and wins success. Used by over 3,000,000 people to build red blood, strength and endurance.



NUXATED IRON

Sole English Agents *for*

ELECTRICAL EXPERIMENTER
SCIENCE AND INVENTION

We are sole distributors for the ELECTRICAL EXPERIMENTER in Great Britain. If you reside anywhere in England, communicate with us and we will see that you are supplied each month.

1/6 the Issue

Specimen Copy sent post free upon receipt of a postal order or stamps for 6d. Address Dept. 7.

Messrs. Geoffrey Parker & Gregg
62, The Mall
Ealing, London, W. 5

American Legion Rings

14K SOLID GOLD FILLED

Guaranteed 20 Years

Exactly like cut. Show that you belong to the Legion by wearing one of these rings. Money back in 5 days if you are not satisfied. When ordering send your size or measurement with piece of string.

Order at once at the special introductory price, $2.75

Send cash, check or money-order.

Theil & Co. No. 1 North 13th Street Philadelphia, Pa.

MONEY for YOU

Add to your Salary—Make extra Pin Money, Start a lucrative business of your own

Spend an hour each day taking subscriptions for the "Experimenter." We'll pay you well and you'll enjoy the work. *Write for full particulars.*

ELECTRICAL EXPERIMENTER
Circulation Dept., 233 Fulton St., N. Y. City

GLORIA SWANSON
Cecil B. DeMille Artcraft Player

WALLACE REID
Paramount Star

Hermo "Hair-Lustr"

(Keeps the Hair Dressed)

FOR MEN AND WOMEN

The hair will **stay dressed** after Hermo "HAIR-LUSTR" has been applied. No more mussy, untidy looking hair. Adds a charming sheen and luster, insuring the **life** of the hair, as well as its **beauty.** Dress it in any of the **prevailing styles,** and it will stay that way. Gives the hair that soft, glossy, well groomed appearance so becoming to the stars of the stage and screen. Guaranteed harmless and **greaseless.**

Two Sizes—50c and $1

$1 size three times the quantity of 50c size. SEND FOR JAR TODAY. Remit in coin, money order, or U. S. stamps, and we will send Hermo "HAIR-LUSTR," and the Hermo Booklet, "Guide to Beauty," prepaid, under plain cover, at once. Use it five days and if not entirely satisfactory, return what is left, and we will REFUND YOUR MONEY IN FULL. Once you use Hermo "HAIR-LUSTR" you will never be without it. *SEND YOUR ORDER TODAY.*

HERMO CO., 542 E. 63rd St., Dept. 102 CHICAGO

"I Would Not Part with it for $10,000"

So writes an enthusiastic, grateful customer. In like manner testify over 100,000 people who have worn it. Conserve your body and life *first.*

The Natural Body Brace

Overcomes **WEAKNESS** and **ORGANIC AILMENTS** of **WOMEN AND MEN.** Develops **erect,** graceful figure.

Brings restful relief, comfort, ability to do things, health and strength.

Wear It 30 Days Free at Our Expense

For Children Also

Does away with the strain and pain of standing and walking; replaces and supports misplaced internal organs; reduces enlarged abdomen; straightens and strengthens the back; corrects stooping shoulders; develops lungs, chest and bust; relieves backache, curvatures, nervousness, ruptures, constipation. Comfortable and easy to wear.

Keep Yourself Fit

Write today for illustrated booklet, measurement blank, etc., and read our very liberal proposition.

HOWARD C. RASH, Pres. Natural Body Brace Co.
286 Rash Building SALINA, KANSAS

ACFIELD'S METAPAD
IT SUPPORTS & BINDS THE FRONT ARCH

Instantly Relieves Metatarsal Arch Affections

Morton Toe, cramping of toes, enlarged little toe joints, sole callouses and spreading of foot. Worn in any Shoe, under or over stocking. Any other foot troubles? Write for full particulars.

C.R.ACFIELD
Foot Specialties
Marbridge Building, Dept. MB 1328 B'way (at 35th St.) N. Y.

LEARN ENGINEERING

Expert electrical engineers are being paid fabulous salaries—thousands needed today. We give you personal and thorough training—practical, technical courses 3 months to 2 years under expert engineers in electricity, steam, gas, auto, armature winding, drafting, etc. Extensive laboratory and shop equipment. **Not a trade school.** Training is condensed—if your time is limited, come to the **Finlay Engineering College**—only one of its kind in the West. Day and night sessions—enroll anytime. Write for FREE catalog, a post card will do.

FINLAY ENGINEERING COLLEGE
1003 Indiana Ave. Kansas City, Mo.

in flight or if the wires were on the ground while testing plane motor and switch on Radio Set was on "Transmit." The capacity of the above condenser was made large so it would not appreciably affect the wavelength of the antenna.

The fan-driven generator used on transmitting ships of course increased the head-resistance. However, actual tests of climbing made with an American Curtiss plane, with and without generators, showed the climbing speed to be reduced only about 8 per cent by the addition of the generator.

The types of Radio-Telephone equipment used by "formation squadrons" was naturally of short wavelength, as a larger wavelength was not necessary for the purposes then needed.

The Navy to-day has available a large type Radiophone which has communicated over distances better than 150 miles.

Much has been said in regard to eliminating the fan-driven generator and having the power given directly from the motor. This is possible, but would it be any more advantageous? A finer degree of power regulation would be necessary and also some method of furnishing power when the motor was shut off. It is, however, a good problem for the Radio Engineer to work on and one that would bring him everlasting fame should he devise a good practical solution to the problem.

In conclusion will state I have endeavored to show the different steps used before arriving at what was last considered the best airplane antenna for Radio-Telephone Inter-Plane Communication. The adoption of other types will most assuredly take place as the requirements are brought out.

Getting Together on the Antenna

By E. T. JONES

(*Continued from page* 1033)

was strung from a stub which was left by the said vile storm, only 20 feet high; the wire was run down to a fence post 6 feet high. I came to the conclusion that this antenna (before testing it out) would be just the thing for long distance Amateurs' work, which was the rage at that time, so I started in one night with a small panel type receiving set constructed by myself (the same receiver used with the large antenna), and was surprised to note that I could not hear any Amateurs, due to the fact,—as I came to the conclusion afterwards,—that the long lengths of wire insulated from each other along their entire length (being connected only at each end), produced a considerable amount of capacity, which made its natural period too large for the reception of Amateurs, other than local ones with considerable power (forced oscillations).

That night, however, "the cat was let out of the bag" when on approximately the same tune as was used in connection with the larger antenna, I picked up Swan Island with a signal strength of 60 (audibility). The slight increase in signal strength may have been caused by the change in weather from November, 1916, to December, 1916, but it is pleasing to say that even the same strength of signal with the exceedingly lower and shorter antenna was a surprise.

It is easy to recognize the importance of using such an antenna in view of the fact that lower antennas do not pick up as much static and that the expense of erecting high receiving antennas is eliminated that this type of antenna should be adopted universally by ALL. Of course a longer length of the same stranded wire could be expected to furnish better results.

Telephone Men Use These a WEEK FREE

ACCEPT this **free** offer and use these great up-to-date books on the telephone in your own home or shop a whole week free.

We will send you all four volumes bound in genuine red morocco leather, 1728 pages and 2000 pictures, without one cent in advance.

Cyclopedia of TELEPHONY AND TELEGRAPHY

Everything about the telephone is explained in them in simple and plain language—theory—practice—operation—from the first experimental line to the modern equipment and complicated switchboards. Not one detail has been overlooked. Every vital fact that you need to make you an expert is in them.

Free Consulting Service

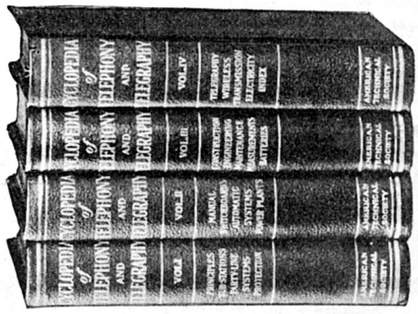
If you wish to keep the books on our easy terms of $2.00 a month, we will include FREE a year's Consulting Membership in the American Technical Society, and you can have the services of our engineers and experts for one year as often as you wish to write in—ask for their help on any subject within the scope of books.

Send the Coupon Now

Don't send any money. Just mail the coupon properly filled out and the books will come to you at once by express collect. Keep them a whole week and use them as if they were your own. Send them back to us if you want to, but give them a trial anyway, and if you keep them send us only $2.80. You can send the balance of the special $14.80 price by paying only $2.00 each month.

Give yourself a chance to make some real money—right now. Send the coupon before you turn this page.

American Technical Society
Dept. T-252 Chicago, U.S.A.



American Technical Society, Dept. T-252, Chicago

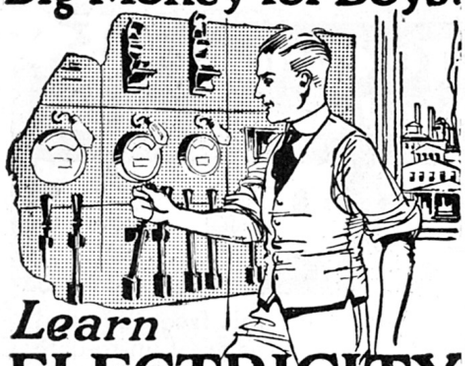
Please send me a set of Telephony and Telegraphy in 4 volumes, express collect. I will send you $2.80 in 7 days and $2.00 each month until I have paid $14.80. If I don't want to keep the books I will return them to you in one week and will owe you nothing.

Name .....

Address .....

Reference .....

Big Money for Boys!



Learn ELECTRICITY

There is a wonderful opportunity right now for boys who like electricity. Boys who are ambitious and will train themselves in spare time can step into positions just as soon as they are ready. Good salaries are offered to start with splendid chances for rapid promotion.

For 28 years the International Correspondence Schools have been training boys for success in electricity and over 200 other subjects. They will help you prepare right at home for a position in the line of electrical work you like best—or in any other work that appeals to you. Thousands of boys, through I. C. S. training, have stepped into fine jobs, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least, and it will bring you information that will start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon *now*.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6220, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

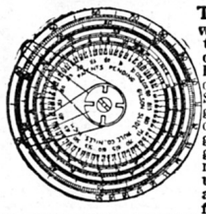
ELECTRICAL ENGINEER	CHEMICAL ENGINEER
Electrician	SALESMANSHIP
Electric Wiring	ADVERTISING MAN
Electric Lighting	Window Trimmer
Electric Car Running	Show Card Writer
Heavy Electric Traction	Outdoor Sign Painter
Electrical Draftsman	RAILROADER
Electric Machine Designer	ILLUSTRATOR
Telegraph Expert	DESIGNER
Practical Telephony	BUSINESS MANAGEMENT
MECHANICAL ENGINEER	Private Secretary
Mechanical Draftsman	BOOKKEEPER
Ship Draftsman	Stenographer and Typist
Machine Shop Practice	Cert. Pub. Accountant
Toolmaker	Traffic Management
Gas Engineer	Commercial Law
CIVIL ENGINEER	GOOD ENGLISH
Surveying and Mapping	STATIONARY ENGINEER
MINE FOREM'N OR ENG'R	CIVIL SERVICE
ARCHITECT	Railway Mail Clerk
Architectural Draftsman	Textile Overseer or Supt.
PLUMBING AND HEATING	AGRICULTURE — Spanish
Sheet Metal Worker	Poultry Raising — French
Navigator	Automobiles — Italian

Name_____

Present Occupation_____ 7-26-19

Street and No._____

City_____ State_____



THE MIDGET SLIDE RULE will solve any problem in addition, subtraction, multiplication, division and proportion. A Log-Log Scale gives any root or power of any quantity. Gives Logarithms, Sines, Tangents, Cosines, Cotangents and the decimal equivalents of fractions to six figures. It is grease and water proof and will give years of service. This rule is not to be compared with the paper utility rules which sell for $1.00 and are put together with paper fasteners. It is accurate, simple to operate and comparison shows that it is undoubtedly the fastest and most complete rule made. Our refund guarantee protects you from loss or disappointment. An instruction book 16 pages, 12 illustrations, is sent with each rule. Diameter of rule 4 in. Made in two models: Metal (white coated steel), $1.00; White Celluloid, $1.25. Leather Case 50c extra. Send for catalogue of Slide Rules. Your money back if you are not satisfied. **Gilson Slide Rule Co., Niles, Mich.**

STAMMERER

Send 10 cents for my remarkable book, "How To Stop Stammering." Kill the fear of stammering. Re education the key.
The Hatfield Institute, 109 N. Dearborn St., Chicago, Ill.

The Fessenden Oscillator

By E. T. JONES

(*Continued from page* 1020)

clamping it to the steel with the field rings, leaving an air gap between, and completing the magnetic circuit of the field.

The oscillating system has a copper tube supported in the air gap between the core and the field without touching either. The supports for the copper tubes are two steel discs, rigidly clamped to a shaft passing through a clearance hole in the center of the core. One end of this shaft is firmly secured to a large steel diafram, whose outer edge is bolted to the front steel ring of the field.

An internal air pressure of 25 pounds is maintained in the oscillator. The oscillator should be placed at least 15 feet below the water line. Best results are obtained when the generator frequency is equal to the natural period of the vibration of the diafram. The velocity of sound thru water is 4.750 feet per second, thru air 1,120 feet per second, both at ordinary temperature, or 70° Fah. Velocity thru water varies with temperature (slightly). The diafram of the oscillator vibrates approximately .01 inch when transmitting.

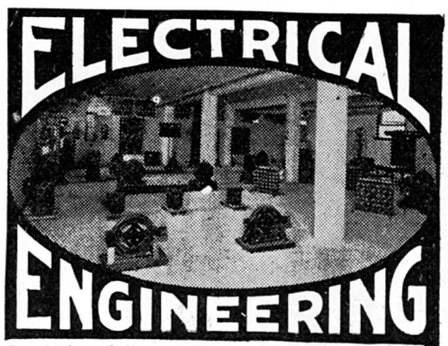
Ocean Beach Set (Description): One motor-generator, 500 cycles A.C. 200 volts for the oscillator armature windings. Both, while sending a constant current of 7½ amperes was maintained in the field of the oscillator (D.C.). When transmitting a 500 cycle note, a current of 11 amperes was sent thru the armature winding of the oscillator. Storage batteries yielded the D.C. supply for the field. The oscillator itself is supported on a steel tripod about one mile from the station and is connected with a submarine cable. For receiving, a pair of 75 ohm receivers is used. The amplifier is being used with exceptionally good results.

THE OSCILLATOR WILL EITHER TRANSMIT OR RECEIVE SOUND WAVES IN THE WATER. *Transmitting:* The field coil is energized by direct current, thereby creating a magnetic field in the air gap at right angles to the surface of the copper tube. When an alternating current passes thru the core winding, currents of electricity are generated by induction in the copper tube. These alternating currents in the tube, together with the magnetic field, produce great forces and cause the tube to move back and forth at the frequency of the alternating current. The motion of the tube is transmitted by the discs to the diafram and to the water in contact with it. The frequency used is approximately 540 cycles per second.

Receiving: The field coils are energized as in sending, and the core winding is connected to the receivers. When incoming sound waves actuate the diafram, motion is imparted to the copper tube. The movement of the copper tube at right angles to the magnetic field produces currents in it, which in turn induce currents in the core winding. The currents in the telephone receivers connected to the core winding produce sounds of the same periodicity as those vibrating the diafram of the oscillator at the distant transmitting station.

DEEP SEA MOVIES.

An interesting type of deep sea diving bell for taking motion pictures under water has been developed in beautiful Catalina Island off the coast of California. The bell is lowered from a specially constructed boat and consists of a dome resting on three adjustable legs. Air is supplied by a pump and pipe line. There is a telephone connection with the surface and glass "eyes" in the dome permit submarine photography.



Des Moines College Des Moines, Iowa
formerly
HIGHLAND PARK COLLEGE
The Great Practical School of the Middle West
Offers a remarkably complete course of Electrical Engineering in one year of 48 weeks, at low cost. A very fine laboratory unexcelled in the country for the performance of real tests and experiments. Several dates for entrance during school year. Other courses offered are the standard 4-year courses in **Civil, Mechanical, Electrical** and **Chemical Engineering.** One-year courses in **Surveying, Highway Engineering, Mechanical Engineering** and **Drafting,** and **Auto Electrical Expert Course.** Write for catalog, stating course in which you are interested. Address

Adolph Shane, E. E., Dean, Des Moines College
145 Highland Park, Des Moines, Iowa

Army Auction Bargains

Tents	$4.25 up	C. W. revolvers	$2.65 up
Saddles	4.65 up	Army Haversacks	.15 up
Uniforms	1.50 up	Knapsacks	.75 up
Teamharness	26.85	Army Gun slings	.30 up

Spring. Rem. cal. 30 single shot rifle for model 1906 cartridges, **$7.77** Ball cart. **$3.50** per 100 **15 acres Army Goods.** Large illustrated cyclopedia reference catalog—428 pages-- issue 1920, mailed 50 cents. **New Circular 10 cents**
FRANCIS BANNERMAN SONS, 501 Broadway, New York

SAVE 25% to 60%
on slightly used
GRAFLEX-KODAKS
Cameras and Lenses of every description. Equal to new. Save money. Write now for **Free Bargain Book and Catalog** listing hundreds of money-saving bargains in slightly used and new cameras and supplies. **All goods sold on 10 days' Free Trial.** Money back if not satisfied. You take no chances dealing with us. We have been in the photographic business over 16 years. Write now.
CENTRAL CAMERA CO., Dept. 112 124 S. Wabash, Chicago

"The Ellis Music Master Reproducer"
made for all phonographs. Pleases the most exacting music lover. Eliminates twang. Perfect harmony of accompaniments, individuality of artists voices and instruments reproduced from records in life like reanimation. It sells on its merits. Send 10c for booklets E, "Hints to Music Lovers" and "Music Masters." Agents wanted.
J. H. ELLIS, P. O. Box 2331, Milwaukee, Wisconsin

YOU Can Double Your Ability to Earn Money! Hold Friends! Win Love and Happiness! Our System of Personal Efficiency tells you **how!** Success Studygram and Personality Sketch for 10c and birth date. Thomson-Heywood Company. Dept. 350, Chronicle Building, San Francisco.

Printing Cheap
Cards, circulars, labels, book, paper. Press $8. Larger $25 Job press $100. Save money. Print for others, big profit. All easy, rules sent. Write factory for press catalog. TYPE, cards, etc. **THE PRESS CO., D-47, Meriden, Conn.**

Raise Belgian Hares for Us
Wonderful profits easily made at home. We furnish class A stock and pay you $7 to $12.50 a pair and express charges. Interesting illustrated catalog and contract **FREE.**
United Food & Fur Association
329 W. 48th St., Dept. E, New York

INDEX TO
Electrical Experimenter
FOR VOLUME 1, 2, 3, 4, 5

This index contains 24 pages and shows every article of interest that has been published since the first issue of the magazine up to and including April, 1918.

It is absolutely indispensable to everybody interested in any kind of electrical research work. With it everything of importance in the advancement of electrical science during the last five years can be readily found.

Price 15c. Postpaid

EXPERIMENTER PUBLISHING CO.
Book Dept. 231 Fulton St., N. Y.

Swear Off Tobacco

Tobacco Habit Banished In 48 to 72 Hours

Immediate Results

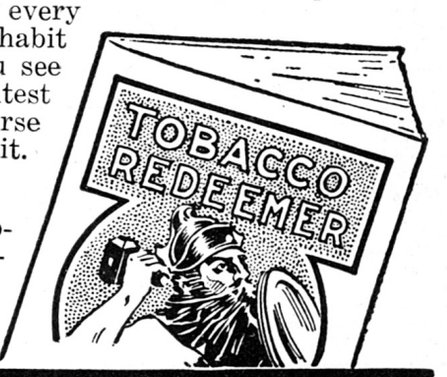
Trying to quit the tobacco habit unaided is a losing fight against heavy odds, and means a serious shock to your nervous system. So don't try it! Make the tobacco habit quit you. It will quit you if you will just take **Tobacco Redeemer** according to directions.

It doesn't make a particle of difference whether you've been a user of tobacco for a single month or 50 years, or how much you use, or in what form you use it. Whether you smoke cigars, cigarettes, pipe, chew plug or fine cut or use snuff—**Tobacco Redeemer** will positively remove all craving for tobacco in any form in from 48 to 72 hours. Your tobacco craving will begin to decrease after the very first dose—there's no long waiting for results.

Tobacco Redeemer contains no habit-forming drugs of any kind and is the most marvelously quick, absolutely scientific and thoroughly reliable remedy for the tobacco habit.

Not a Substitute

Tobacco Redeemer is in no sense a substitute for tobacco, but is a radical efficient treatment. After finishing the treatment you have absolutely no desire to use tobacco again or to continue the use of the remedy. It quiets the nerves and will make you feel better in every way. If you really want to quit the tobacco habit—get rid of it so completely that when you see others using it, it will not awaken the slightest desire in you—you should at once begin a course of **Tobacco Redeemer** treatment for the habit.



Results Absolutely Guaranteed

A single trial will convince the most skeptical. Our legal, binding, money-back guarantee goes with each full treatment. If **Tobacco Redeemer** fails to banish the tobacco habit when taken according to the plain and easy directions, your money will be cheerfully refunded upon demand.

Let Us Send You Convincing Proof

If you're a slave of the tobacco habit and want to find a sure, quick way of quitting "for keeps," you owe it to yourself and to your family to mail the coupon at the right or send your name and address on a postal and receive our **free** booklet on the deadly effect of tobacco on the human system, and positive proof that **Tobacco Redeemer** will quickly free you from the habit.

Newell Pharmacal Company
Dept. 521 **St. Louis, Mo.**

Free Book Coupon

NEWELL PHARMACAL CO.
Dept. 521 **St. Louis, Mo.**

Please send, without obligating me in any way, your free booklet regarding the tobacco habit and proof that **Tobacco Redeemer** will positively free me from the tobacco habit.

Name .....

Street and No. .....

Town ..... State .....

Opportunity Ad-lets

YOU will find many remarkable opportunities and real bargains in these columns. It will pay you to read and investigate the offerings made every month by reliable firms, dealers and amateurs from all over the country. No matter what you may be seeking, whether supplies, automobile accessories, the opportunity to make money, or anything else, you will find listed here the best and most attractive specials of the month.

Advertisements in this section nine cents a word for each insertion. No advertisement for less than 75c accepted. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

Ten per cent discount for 6 issues, 20 per cent discount for 12 issues. Objectionable or misleading advertisements not accepted. Advertisements for the April issue must reach us not later than March 1.

The Circulation of the Experimenter is over 130,000 and climbing every month

EXPERIMENTER PUBLISHING CO., INC., 233 Fulton Street, New York, N. Y.

Auto Accessories.

Wanted—Good live selling agents for our garage testing instruments and publications. Write for catalogue and particulars. H. E. Phillips & Company, Service Division, Union City, Ind.

Battery Charging pays big profits. City current or gas engine operates. Easy terms. Hoberts, Troy, Ohio.

Auto Motors and Supplies. Buick, Hupp, Franklin, Michigan, Everett, Hudson, Chalmers. Both water and air-cooled motors, $40.00 each and up. Bosch Magnetos, $15.00 each and up. Presto Tanks, $5.00. Coils, Carburetors, Head Lamps, Horns, Air Compressors, Generators, Starters. Write for bargain bulletin second hand auto accessories. Johnston, West End, Pittsburgh, Pa.

Tires—Direct to you prices. Exclusive representatives wanted each locality to use and sell Mellinger Extra Ply Tires. Guarantee Bond 8,000 Miles. Sample Sections furnished. Mellinger Tire Company, 980 Oak, Kansas City, Missouri.

Power increased, carbon eliminated; results guaranteed. Write for booklet. No-Leak-O Piston Ring Co., Baltimore, Md.

Fords Start Easy in Cold Weather. Will run 34 miles per gallon on cheapest gasoline or half kerosene using our 1920 carburetors. Increased power; styles for all motors; can attach them yourself. Big profits to agents; money back guarantee; 30 days' trial. Air-Friction Carburetor Company, 270 Madison St., Dayton, Ohio.

Aeronautics.

100 Model Aeroplanes, good flyers; 15c. brings working drawing and prices. F. Bruland, Redford, Mich.

Build you own Aeroplane; materials on installments, in the rough or cut to fit ready to assemble. Also machines completed. G. Angeles, Centralia, Washington.

Authors—Manuscripts.

$50 to $150 a Week writing Stories and Photo-Plays. Previous Acceptance Not Essential. Dept. 57, New York Literary Bureau, 141 W. 36th St., New York City.

Moving Picture Plays.

Earn $1,200 a Year in Spare Time writing photo-plays. Experience unnecessary. Send for free book, valuable information, special prize offer. Photo Playwright College, Box 278 E-10, Chicago.

Photoplays Wanted. Big prices paid. You can write them. We show you how. Free particulars. Rex Publishers, Box 175, E-10, Chicago.

Write Photoplays. Make money at home, $50 to $100 each. Great demand. Experience unnecessary. Particulars free. J. Cumbo, 1915 So. Kedzie, Chicago.

Miscellaneous.

Be Well, Strong, Happy, Successful. Drugs and surgery unnecessary. Modernized Natural Healing insures success, also a profitable, philanthropic and educational profession. Convincing literature free. Science Institute, E-1818 N. Wells, Chicago.

Three Master Keys. Opens average locks. 50c set. Lattime, Locksmith, R 78 Dexter St., Medford, Mass.

Guaranteed—"Titan," "Tufkote" roof paint, heavy bodied, waterproof, fireproof, limited period 60c. gallon, barrels; dustproof "Waxol" wood floor oil $1.00 gallon; wizard leak repair mastic cement $1.00. Martinek Company, 405 Lexington Avenue, New York.

Fine beautiful, evergreen, ornamental firs, any address, $1.00. Order now. B. B. Lee, Sta. A, Vancouver, Wash.

Wanted—Small Gasoline and Steam Engines, Small Lathes, Drill Presses and other light machinery. Will pay high cash prices for good material. Johnston, West End, Pittsburgh, Pa.

Genuine Diamond mounted in brass for use as drill, scribe or cutter, prepaid, One Dollar. National Supply, 1208-10 N. Clark St., Chicago, Ill.

Wanted to Buy.

Cash for Old False Teeth—We pay up to $35.00 per set (broken or not). Also buy discarded gold, jewelry, gold crowns, bridges, platinum, diamonds, watches and silver. Send now. Cash by return mail. Package held 5 to 10 days for sender's approval of our offer. U. S. Smelting Works, Dept. 73, Chicago, Ill.

Experimenter Publishing Co., Inc.,
233 Fulton Street,
New York, N. Y.

Gentlemen:—

Inclosed is $3.74 for which insert the inclosed ad in the February, 1920, issue of the Electrical Experimenter and Radio Amateur News. The enclosed Money Order covers the cost.

Both of your magazines are GREAT, and I couldn't get along without them, especially the E.E. As to the R.A.N. its the best in its line. I am watching for the day when the Wireless Telefone will be in common use, and to help along the cause I am subscribing.

Yours for PROGRESS!

(Signed) CARL A. HANSEN.

Agents Wanted.

Agents. Snappiest household line on earth; red hot sellers, steady repeaters, 100% profit; 500 light weight, fast selling, popular priced necessities. Agent's outfit free. Get busy—quick—write today; postal will do. American Products Co., 1502 American Bldg., Cincinnati, Ohio.

Insyde Tyres, inner armor for automobile tires double mileage and prevent punctures and blow-outs; quickly applied; cost little; demand tremendous; profits unlimited. Details free. American Automobile Accessories Co., Dept. 54, Cincinati, Ohio.

Free electrical and wireless apparatus for selling a household article that every housewife needs. Let me send you one dozen prepaid that sell at 25c. a set; catalogue and full information. Beck Novelty House, 1298 Carroll St., Brooklyn, N. Y.

Man or Woman, start anywhere; materials that cost 25c. retail for $5. Details free. Lee, Dept. 5, 3401½ University Ave., Los Angeles, Cal.

Sell Victorclean Washing Wonder. It is a wonderful repeater. Free samples to boost sales. Skytt, 725 E. 5th St., Duluth, Minn.

Free Samples. Best line of Cold Creams, Face Powder, Perfumes, Remedies, Soaps, Extracts. Big profits; catalogue free. Western Laboratories, 1958 W. Van Buren, Chicago.

Your Opportunity. Get in business for yourself; mail order or local; manufacture your own products; employ other agents; everything given clearly in our big magazine of plans, schemes and ideas. Three months, 25c.; sample copy, 10c. Special Service, 421 Shannon Bldg., Pittsburgh, Pa.

Agents—$40-$100 week; free samples; gold sign letters; anyone can put on store windows; big demand; liberal offer to general agents. Metallic Letter Co., 433Z N. Clark, Chicago.

Agents Wanted. (Cont'd.)

Beginners. Complete "Mail Order System" C. Box 1005, Atlantic City.

Wanted. Agents to call on garages and service stations. Best line of testing instruments and publications on the market. Complete catalogue. H. E. Phillips & Company, Service Division, Union City, Ind.

Make $30 Next Saturday. Speederator for Fords selling like wildfire. Used by Ford Motor officials. Makes any Ford run like a Packard. Stops stalling and bucking. Put on quick, instant satisfaction. No holes to bore. Sell ten to twelve a day easy. Splendid profits and exclusive territory. Write quick for information. Address Perrin Company, 1042 Hayward Bldg., Detroit, Michigan.

Agents. Big returns, fast office seller; particulars and samples free. One Dip Pen Co., 12 Daily Record Bldg., Baltimore, Md.

500 Agents wanted at once for Mitchell's magic marvel washing compound; 300% profit, enormous repeater. Washes clothes spotlessly clean in 10 to 15 minutes; 1,000 other uses in every home. Astounds and delights every woman. Nothing else like it. Nature's mightiest cleanser. Contains no lye, lime, acid or wax. Free samples furnished to boost sales. We positively guarantee the sale of every package. Exclusive territory. Own your own business. You cannot fail to make big money. Barber, Ohio, made $600 last month. Send for free sample and proof. Hurry, hustle, grab this chance. L. Mitchell & Co., Desk 318, 1312-1314 E. 61st St., Chicago.

Mexican Diamonds flash like genuine, fool experts, stand tests, yet sell for 1-50th the price. Few live Agents wanted to sell from handsome sample case; big profits, pleasant work. Write today. Mexican Diamond Imptg. Co., Box F1, Las Cruces, N. Mex.

It is Easy to knock out $100 to $200 week with our simplified plans building and selling cabinet phonographs. We supply the motors, tone-arms, hardware, cabinets in pieces with ready built horn for five different models. Experience unnecessary. No cutting, no fitting, no special tools required. You simply assemble and sell. We give you exclusive territory with complete free instructions and assistance to build the Makafone. Representatives wanted everywhere. Hundreds already in the field making big money. Write today. Modern Co., 176 Springer Bldg., 313 So. Clinton St., Chicago, Ill.

Wonderful Chance. Men's Shirts and Furnishings at wholesale rates or make $10 daily as agent starting real business. Goodell Co., 105 Duratex Bldg., New York.

$10 Daily refinishing chandeliers, brass beds, automobiles by new method, without capital or experience. Free particulars and proofs. Write today. Gunmetal Co., Avenue D, Decatur, Ill.

Signs for store and offices. Entirely new; $50 week easily made. Chicago Sign System, G, 326 River St., Chicago.

Chemicals.

Antimony Metal, powdered or lump, 25c per ounce postpaid. Robert Sagebiel, 25 W. Second St., Dayton, Ohio.

25 New Electro-Chemical Formulas, latest. Send dime. Burden, Red Cloud, Nebr.

Cameras, Supplies—Photo Developing.

Mail us 15c. with any size film for development and six velvet prints. Or send six negatives any size and 15c. for six prints. Or send 25c. for one 8 x 10 mounted enlargement. Prompt, perfect service. Roanoke Photo Finishing Co., 255 Bell Ave., Roanoke, Va.

Clean, Neat, Perfect Kodak Finishing at the lowest prices. Work returned the same day received. Send film for sample print and copy of catalogue on developing, printing, enlarging and hand coloring, also copy of Photo Craft Magazine, which will help you make better pictures. Photo Craft Co., Box 69, Ann Arbor, Mich.

Cameras. Lowest Prices. Supplies and Printing at reduced rates. Eliminate the middleman. Deal direct with us. Catalog free. Pearl Photo Place, 640 E. Clementine St., Philadelphia, Penna.

Help Wanted.

Firemen, Brakemen, Baggagemen, $140-$200, Colored Porters, by railroads everywhere. Experience unnecessary. 897 Ry. Bureau, East St. Louis, Ill.

American Made Toys Wanted. An opportunity for home-workers on small scale and manufacturers on large scale. Unlimited quantities needed of toy soldiers, army, navy, marines, cannons, machine guns, warships and other toys and novelties. Greatest chance for industrious people for independent business. Enormous demand and future in American made toys, all over United States, Canada, Mexico and South America, with over 50,000 10 cent stores and toy dealers. This new American industry stands out conspicuously. Factories are established, people trained, machineries made. Christmas sets needed in millions this year. The great hit for 1920 without any competition. We are buyers of these goods all year, paying fixed prices. Attractive prices offered for painted goods. Experience or tools unnecessary. Hundreds and more made complete per hour. Casting form outfits from $3.00 up. If you mean business, send for booklet and information free. Toy Soldier Manufacturing Co., 32 Union Square, New York.

Detectives and Investigators are in demand. Travel and earn big money. Learn this fascinating profession by home study. Particulars free. American School of Criminology, Dept. E, Detroit, Mich.

Detectives Earn Big Money. Excellent opportunity. Particulars free. American Detective System, 1968 Broadway, New York.

Waterman's Self-Instruction Civil Service Courses; new 336-page book. Quickly prepares for all examinations. By mail, $2.50. Money back if not satisfactory. Information free. Write to-day, Chicago Civil Service College, 803 Kesner Bldg., Chicago.

Be a Mirror Expert. $3-$10 a day; spare time home at first; no capital; we train, start you making and silvering mirrors French method. Free Prospectus. W. R. Derr, Pres., 579 Decatur Street, Brooklyn, N. Y.

U. S. Government wants hundreds Railway Mail Clerks. Beginner's salary, $1,300 year. Men, women, 18 up. List positions free. Write to-day. Franklin Institute, Dept. O 26, Rochester, N. Y.

Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 5665 St. Louis, Mo.

Become Auto Experts. Hundreds needed. $35.00 week. Earn while learning. Franklin Institute, Dept. O 806, Rochester, N. Y.

Health Without Drugs

Stop Dying. Learn How to Live. "Return to Nature." The most wonderful book on the prevention and cure of all diseases of the body, mind and soul. Helps in the most stubborn and given-up cases. No expense, no hardships. Natural, rational home treatment. No drugs or operations, but water cure, fasting, diet, sun and air baths, earthpower and new-life forces. Price, cloth, $3.00; paper cover, $2.00. Special price E. E. reader, paper cover edition, $1.00 postpaid. New Life Center, Box 185, Butler, N. J., U. S. A.

The Abuse of the Marriage Relation. For single, engaged and married men and women. Saves disappointment, prevents diseases and makes happiness. Postpaid for seventeen 3c stamps. Nature Cure Publishing Co., 110 E. 41st St., New York.

Florida Nature Cure and Natural Life Resort. Ideal location. All rational agents used suited to individual requirements. Dr. Benedict Lust, Tangerine, Fla.

Dr. Benedict Lust Nature Cure Resort "Youngborn." Butler, N. J. One of the oldest, best equipped and most successful drugless institutions. Prospectus free.

Health.

Pyorrhea (Rigg's Disease—Bleeding or Swollen Gums). H. E. Kelty, D.D.S., M.D., pyorrhea specialist for 15 years, has developed a successful home treatment for pyorrhea, purifying, healing, preventative. Full month's treatment, $1 postpaid. Or write for free booklet. Pyorem Mfg. Co., 439 Seventh St., Brooklyn, N. Y.

My-T-Fine Scalp Cleaner. A new hair wash. Perfect dandruff eradicator. Cleans the scalp, strengthens the roots, preserves the hair. Absolutely harmless. 25c postpaid. My-T-Fine Scalp Cleaner, No. 564 Central Avenue, Brooklyn, N. Y. Agents wanted.

Cigarette, pipe or chewing habit conquered. Guaranteed. Write for free brochure. Edw. J. Woods, TB-300 Station F, New York.

Tobacco or Snuff Habit Cured or no pay; $1 if cured. Remedy sent on trial. Superba Co., SA, Baltimore, Md.

Free—Stop using tobacco. We will give free information how to conquer habit easily and permanently. Results Guaranteed. Anti-Tobacco League, Dept. C, Omaha, Nebr.

Too Fat? Reduce weight easily, pleasantly, no self-starvation, no strenuous exercise. Reliable, guaranteed. Obtain Oil of Korein at any busy pharmacy or write for free brochure to Korein Co., NA-300, Sta. F., New York.

Business Opportunities.

You can earn over thirty dollars weekly working spare time for us. H. E. Phillips & Company, Service Division, Union City, Ind.

Raise Giant Rabbits for Me. I furnish breeders cheap and buy all you raise at 30c. to 60c. per pound alive. Hundreds make big money. Send 10c. for Breeders' Instruction Book, contract, price list, etc. Y, Frank Cross, 6407 Ridge, St. Louis, Mo.

Raise Silver Foxes. Exceptional Opportunity. Large profits. Easy to raise. Will not interfere with your regular occupation if desired. Particulars free. C. T. Dryz, 5224-75 S. Maplewood Ave., Chicago.

Luminous Paint makes watches, clocks, etc., visible in the dark; electric light switch plates, pull chains, visible at night; easily applied. Large bottle 50c (coin) prepaid. Send 1c stamp for circular. Illuminant Co., 744L No. Lockwood, Chicago.

Enter a new business. Earn $3,000 to $6,000 yearly in professional fees making and fitting a foot specialty, openings everywhere with all the trade you can attend to; easily learned by anyone at home in a few weeks at small expense; no further capital required; no goods to buy; job hunting, soliciting or agency. Address Stephenson Laboratory, 18 Back Bay, Boston, Mass.

Substantial manufacturing corporation wants capable men to establish branch and manage salesmen; $300 to $1,500 necessary. You handle own money. Will allow expenses to Baltimore if you will qualify. For particulars address Secretary, 416 N. Howard St., Baltimore, Md.

I Made $30 a Week evenings with a small Mail Order Business. Home Free Booklet tells how. 2c postage. Alex Scott, Cohoes, N. Y.

Money-Talks Magazine. Published for progressive men. Send for sample copy. 70-B Park Place, Newark, New Jersey.

Dollars Yearly in Your Back Yard. No ginseng, mushroom dope. New ideas. Investigate. Particulars free. Metz, 313 East 89, New York.

3,384 Moneymaking Plans. Formulas. Trade-Secrets. "Encyclopedia Business Opportunities." 3 volumes $1. Ideal Book Shop, 5501-EV North Robey, Chicago.

Just Out! Forty manufacturing processes and working formulas in current issue of "The Process Bulletin," 10c postpaid. Henry Fitzgerald, 15 West 65th St., New York.

"Quick-Action Advertising—How it is Building Business for the Progressive Advertisers of America": A little story of results, told by the advertisers themselves—not the publisher. You will be interested in reading this little booklet which we have prepared for prospective advertisers, a copy of which will be gladly mailed to you upon request. It tells you how to talk business with 1,000,000 intelligent, interested and responsive Americans every month—men who know what they want and who have the money to buy it. Write for particulars and rates—today. Douglas Wakefield Coutlee, 225 West 39th St., New York.

Breed Canaries. Profitable pastime. Particulars free. Bird Farm, Lynnhaven, Virginia.

Amazing Profits manufacturing "Puffed Crisp." Delicious confection. Begin at home. Machine, instructions complete, $6.50. Samples 10c. "Besco," 3253-Eo Belleplaine Ave., Chicago.

Salesmen Wanted.

Salesman—Side or main line, to sell low priced 5,000-mile guaranteed tires. 30 x 3½ non-skid sells for $11.95; other sizes in proportion. Good money-making proposition for live wires. Write, Consolidated Tire Co., 616 So. Michigan, Chicago.

Young Americas. Sells every family. 100% up. A future for U. Permanent. Sample 30c. Dept. J, Box 527, Stanley, Wis.

Stamping Names.

Make $19 a hundred stamping names on keychecks. Send 25c for sample and particulars. Ex Keytag Co., Cohoes, N. Y.

Scenery For Hire.

Collapsible Scenery for all plays. Decorations. Amelia Grain, Philadelphia.

Tricks, Puzzles and Games

Tricks, Puzzles, Magical Apparatus, Plays, Stage Supplies, Mind-reading Acts, Sensational Escapes and Illusions. Send 10c for our big new 1920 catalog, 100 pages, just off the press. Oaks Magical Co., Dept. 549, Oshkosh, Wis.

Magic. Entertain at home. Tricks, puzzles, novelties. Big Catalogue A, 25c. Martinka & Co., Inc., Harry Houdini, President, 493 Sixth Avenue, New York City.

Illusions—Stage tricks with 500 illustrations. Catalogue, 15c. Small catalogue free. Hornmann Magic Company, 304 W. 34th St., New York.

Magic—Card Tricks. Sensational escapes, jokes, novelties. Everything in the amusement line. Large illustrated catalogue of a thousand tricks free. Write today. Largest amusement goods manufacturers in the world. Heaney Magic Co., Desk 210, Berlin, Wis.

Books.

Books for Men. Also "classy" pictures. Catalog free. United Sales Co., Springfield, Ill.

Books on Sex for men and women. Catalog free. United Sales Co., Springfield, Ill.

Rare instructive and entertaining books. Catalog free. United Sales Co., Springfield, Ill.

World's Best Book for Auto Mechanics. Covers Elementary Electricity, Motor Car Electric Systems, The Gas Engine and Driving Cars. Nearly six hundred diagrams. Prepaid to you for $2.50. Order to-day. H. E. Phillips & Co., Service Division, Union City, Ind.

Crucified Seer Emmerich, Nativity, Egypt, and Cana; 4 books, 20c. Klein Co., Brandon, Minn.

World-Romic System. Masterkey to all languages. Six textbooks, $1.44; French chart, 37c.; Spanish, 37c.; aviation dictionary, $1.50; French-English aviation dictionary, 61c. Languages, 143 W. 47th St., New York.

Dear Reader. If Occult, New-Thought and Scientific books appeal to you, send for my catalog, it's free. I have books on Personal Magnetism, Concentration, Spiritualism, Clairvoyance, Seership, Will, Mind, Hypnotism, Mesmerism, Character Reading, Healing, Mysticism, Success, Salesmanship, Mechanics, Entertainments, etc. A. W. Martens, J-49, Burlington, Iowa.

"How to Thought Read." Mind Reading at any Distance, 20c. "Hypnotic Suggestion" the Secret of Success. 208 pages, $1.00. Circulars free. Science Institute, E1818 North Wells, Chicago.

Book of Nature. By Dr. Faulkner. Plain facts about sex matters every man and woman, married or about to marry, should know. 10c. United Sales Co., Springfield, Ill.

Star Amateur Electrician. 12c. Pocket size. Joel Tillberg, Proctor, Vermont.

For the Amateur Wireless Man. The Radio Amateur. Marion, Illinois. 75c per year.

Idea Exchange, an Amateur's monthly. Year, $1.00. Copy, 10c. If interested in helping edit this magazine, send in your stories, poems, cartoons, etc., at once! Carl A. Hansen, 828 Eighth Ave., Brookings, So. Dak.

Concordia Magazine contains essays, short stories, travel stories, boy scout news, editorials, current events and poetry, formulas and plans. Two years' subscription, 50c. Concordia Magazine, 9 Water, York, Pa.

Educational—Nature laws married and engaged people should know, 50c. 150 modern house building plans and designs, $1.00. Other books, catalogue free. Central Company, 601 Ninth Ave., New York.

Back Issues of this and other magazines supplied by Boston Magazine Exchange, 107 Mountfort St., Boston.

Just Off the Press—Design and Construction of Audion Amplifying Transformers, Radio and Audio Frequency Type. This latest and important book by Mr. Edward T. Jones, late Associate Editor of "Radio News," will be of great interest to all radio amateurs thruout the land. The transformers shown in these books have never been described in print before, and have usually been considered a manufacturer's secret. Anyone who has several vacuum tubes cannot afford to do without this book because it will enable him to build the necessary amplifying transformers very readily. The designs are very simple and rugged, and anybody can make them without much trouble whatsoever. Mr. Jones, the author, is a practical man who is an experimenter himself and knows whereof he speaks. The book is printed on good paper and has an attractive cover in two colors. Paper bound. Size 5 in. x 7 in. Contains many illustrations, diagrams and working data necessary to build the transformers. Price, postpaid, 25c. The Experimenter Publ. Co., Book Dept., 233 Fulton St., New York.

Old E. E. Back Numbers. We have some valuable old E. E. back numbers on hand as follows: 1915—Jan., March, April, May, June, July, Aug., Sept., Oct., Nov. and Dec.; price each, 35c. 1916—Jan., March, May, June, Nov., Dec.; price each, 35c. 1917—Jan., April, May, June, Aug., Nov., Dec.; price each, 35c. 1918—March, May, June, July, Aug., Sept., Dec.; price each, 35c. 1919—Jan., Feb., 35c.; March, April, May, June, July, Aug., Sept., Oct., Nov. and Dec., price each, 20c. 1920—Jan., 20c. We can fill orders at once upon receipt of your remittance. If you have not these numbers already, now is your chance to get them, as they probably will be snapped up very quickly. Experimenter Publishing Co., 233 Fulton St., New York City.

Experimental Electricity Course in 20 Lessons. By S. Gernsback and H. W. Secor, E.E. A Course of the theory and practice of Electricity for the Experimenter. Every phase of experimental electricity is treated comprehensively in plain English. New experiments are described and explained and nearly every application of Electricity in modern life is given. 160 pages—400 illustrations. Flexible cloth cover, 75c postpaid. Stiff cloth cover, $1.25 postpaid. Experimenter Publishing Co., Book Dept., 233 Fulton St., New York City.

(*Continued on page* 1094)

(Continued from page 1093)

Books. (Cont'd.)

Wireless Course in 20 Lessons. By S. Gernsback, A. Lescarboura and H. W. Secor, E. E. Tells you everything you want to know about "Wireless" theory, practice and history. A clear, concise course on every phase of this subject. 160 pages—350 illustrations, 30 tables. Flexible cloth cover, 75c postpaid. Stiff cloth cover, $1.25 postpaid. Experimenter Publishing Co., Book Dept., 233 Fulton St., New York City.

How to Make Wireless Receiving Apparatus. 100 pages, 90 illustrations. Only strictly modern radio apparata are described in this book and the illustrations and descriptions are so clear and simple that no trouble will be experienced in making the instruments. Paper covered. 25c postpaid. Experimenter Publishing Co., Book Dept., 233 Fulton St., New York City.

How to Make Wireless Sending Apparatus. 100 pages, 88 illustrations. Written and publisht entirely for the wireless enthusiast who wants to make his own radio apparatus. Contains more information on "how to make it" than any other book we know of. Paper bound, 25c prepaid. Experimenter Publishing Co., Book Dept., 233 Fulton St., New York City.

Exchange.

Sell my ½ kilowatt compound wound D. C. 115 V. dynamo with field rheostat. Robin & Myer make. Hardly used. My price here $40. M. Anderson, Ardmore, S. Dak.

Cratton & Lambert Brazier No. Eleven for sale. Absolutely new, at a bargain. Address B. F. Best, Jr., Goldsboro, N. C.

Sell "NAA" receiving transformer, $8.00. Navy type receiving transformer, $17.00. Drafting outfit, $10.00. Developing outfit, $7.00. Raymond Fiedler, 70 Sargent St., Lawrence, Mass.

Sale—Electrical Experimenters. 1915-1916 copies, 35c each. 1917-18 copies, 30c each. F. Kessler, 853 E. Main, Decatur, Ill.

Exchange new telegraph outfit for small dynamo. Charles Malpede, 1248 McAllister Place, Chicago, Ill.

Sale—Send stamp. List of electrical and radio apparatus parts. Magazines and books. Stassen R 1, W. St. Paul, Minn.

Six $5 Electrical Water Purifiers. I want a small film camera; electro motor; $10 set telephones; or offers. Clarence Skinner, Topeka, Kansas.

Buy, Sell, Exchange. Wireless and electrical goods. Murdock, Clapp-Eastham, Thordarson, Brandes, etc. Send 10c. stamps for our circulars listing new standard apparatus at less than manufacturer's prices. We have to exchange: Wireless, Electrical, Optical, Cameras, Printing Presses, Typewriters. Large list free. LaRoy Zehrbach, 10 College Ave., Hiram, Ohio.

General Electric Volt and Ammeter Type D.K.5, 0 to 30 volts and 0 to 15 amps., for shotgun. R. C. Wickersham, Tipton, Indiana.

For Sale—Martin Vibroplex, $9. I. G. Wilson, 341 S. Lime, Lexington, Ky.

For Sale—De Forest P-500 Audion Panel with 20-V. "B" Battery, excellent condition. Price, $17.50. W. H. Stonerook, 3687 5th St., San Diego, Calif.

For Sale—Experimental Shop, consisting of screw cutting engine lathe, 9-in. swing, Goodell-Pratt lathe complete, other tools, etc. Robert Bohaty, 434 East 77th St., New York City.

For Sale. No. 28, No. 30, No. 32 green silk wire. Free samples. R. N. Winters, 404 Pearl St., Camden, N. J.

For Men.

Detectives Earn Big Money. Travel. Great demand. Experience unnecessary. We train you. Write for free particulars. American Detective System, 1968 Broadway, N. Y.

Get Vital Strength. Retain youthful vigor. Wonderful results. Intensely interesting booklet free. Winslow H. Chase, Washington, D. C.

Pyorrhœa, loose teeth, bleeding gums. Treatment—advice, by graduate specialist, Harvard University, $1.00. Correspondence invited. Harvard Dental Specialty Co., Cadiz, Ohio.

Send Us Your Dull Safety Razor Blades. We will re-sharpen them so they shave like new blades for 3c each, any kind. Quick service. Entire satisfaction guaranteed. Antiseptic astringent pencil given free with every dollar order if you mention "Electrical Experimenter." Send your blades to-day. Keenedge Company, Inc., Dept. L, 184 Washington St., Chicago, Ill.

Safety Razor Blades re-sharpened; double edge, 35c per dozen; single edge, 25c per dozen; we pay postage. White Star Safety Razor Sharpening Co., 611 Chestnut St., Northside, Pittsburgh, Pa.

Oilproof Caps—"The Cap that Oil Can't Soil," from tan or black leatherette, made in latest style with non-breakable peak, $2.00. Zuckerman, 204 W. 23d St., New York.

For the Hair

I Was Bald. Obtained hair growth by an Indian's ointment containing genuine bear oil and rare plant juices. Many others have had wonderful results. Fine for dandruff. Harmless. Will send box, postpaid, with recipe, 10c. John Hart Brittain, 150 E. 32d St., BB-300, New York.

Patent Attorneys.

Millions spent annually for ideas! Hundreds now wanted! Patent yours and profit. Write to-day for free books—tell how to protect yourself, how to invent, ideas wanted, how we help you sell, etc. 212 Patent Dept., American Industries, Inc., Washington, D. C.

Patents Procured—Trade Marks Registered. A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Richard B. Owen, 130 Owen Bldg., Washington, D. C., or 2278-T Woolworth Bldg., New York.

John M. McLachlen, Atty.-at-Law. Patents, trade marks, copyrights. 410 McLachlen Bldg., Washington, D. C.

Patents. Foremost word free. Write now. Metzger, Washington, D. C.

M. F. Miller, Ouray Bldg., Washington, D. C. Patent Attorney, Mechanical and Electrical Expert. Best quality of work and results. Moderate charges. Advice free.

"Investors' Adviser" sent free on request. William C. Linton, 918 F Street N. W., Washington, D. C., 363 University Street, Montreal, Canada.

Patent Attorney. Consulting Engineer. High-class patent service in all its branches. Write for particulars. M. H. Loughridge, 1457 Broadway, New York.

Don't Lose Your Rights to patent protection. Before disclosing your invention to anyone, send for blank form "Evidence of Conception" to be signed and witnessed. Form and information concerning patents free. Lancaster and Allwine, 242 Ouray Bldg., Washington, D. C. Originators of the form "Evidence of Conception."

Inventions Patented, trade marks registered, labels, prints, publications copyrighted; prompt service, reasonable fees, plain advice; request detailed information before placing your business. Jaynes & Jaynes, 802 Kellogg, Washington, D. C.

Patents—Herbert Jenner, patent attorney and mechanical expert, 622 F St., Washington, D. C. I report if patent can be had and its exact cost. Send for circular.

Patents—Fees in installments. Frank T. Fuller, formerly lieutenant, Engineers, Washington, D.C.

Patents—Prompt, personal, efficient service by an attorney-at-law, skilled in all branches of patent practice. Over 12 years' actual experience; full information upon request. B. P. Fishburne, 330 McGill Bldg., Washington, D. C.

Inventors, send sketch of model of your invention for opinion concerning patentable nature and exact cost of applying for patent. Book, "How to Obtain a Patent," sent free. Gives information on patent procedure and tells what every inventor should know. Established twenty-five years. Chandlee & Chandlee, 414 Seventh St., N. W., Washington, D. C.

For Inventors.

"Sell or Finance Inventions." Read Money-Talks Magazine. Send for free sample copy. 70-B Park Place, Newark, N. J.

Brooklyn Experimental and Tool Co., 462 Ridgewood Ave., Brooklyn, specializes in small money-making articles. Send your ideas to us for free advice as to practicability and estimate for model and patent. All communications strictly confidential.

Inventors, protect yourselves. Record idea before exposing it to anyone, even myself or other attorneys. Klein Cons. Eng., Reg. Patent Attorney, 21 Park Row, New York.

Inventors—We do experimental, model, tool, die and jig work; light manufacturing. Miller & O'Brien Mfg. Co., Saint Paul, Minn.

"Inventors' Guide" free on request; gives valuable advice and information for all inventors. Write Frank Ledermann, Registered Patent Attorney, 17 Park Row, New York.

Inventors write me about patents. My fees payable monthly. Booklet free. Frank Fuller, Washington, D. C.

900 Mechanical Movements, also illustrations explaining 50 Perpetual Motions. My book, "Inventor's Universal Educator," fifth edition, tells how to procure and sell patents. Government and other costs. Covers the matter from A to Z. 160 pages elegantly bound. Contains noted decisions of U. S. Supreme and State Courts on patent cases. Mechanical Movements greatly assist inventors, suggest new ideas that may prove of great aid in perfecting inventions. Tells how to select an attorney. Has valuable information regarding Patent Sharks, Selling Agents and Brokers. Price $2. Postage free everywhere. Fred G. Dieterich, 603 Ouray Bldg., Washington, D. C.

Inventions Wanted—Cash or royalty for ideas. Adam Fisher Mfg. Co., 205 St. Louis, Mo.

Printing.

1,000 Newmarket Bond Letterheads, prepaid, $2.50. Envelopes $2.75. Echo Printery, Wauwautosa, Wis.

3,000 Two-Color Labels, $1.25. Irvin J. Wolf, Station E, Philadelphia.

Embossed note sheets and envelopes, hundred each, dollar eighty. Daniels Co., Pittston, Pa.

Song Poems Wanted.

Write the Words for a Song. We revise poems, write music and guarantee to secure publication. Submit poems on any subject. Broadway Studios, 197C Fitzgerald Bldg., New York.

Write the Words for a Song. We write music and guarantee publisher's acceptance. Submit poems on war, love or any subject. Chester Music Co., 920 So. Michigan Ave., Room 265, Chicago, Ill.

Song-writers. Market your compositions. Our successful plan brings results. Work examined free and honest advice given. Morrison Music Shop, Dept. E, Indianapolis, Indiana.

You Write Words for a Song—We write the music, publish and secure a copyright. Submit poems on any subject. The Metropolitan Studios, 914 So. Michigan Ave., Room 113, Chicago, Ill.

Write a Song—Love, mother, home, childhood, patriotic or any subject. I compose music and guarantee publication. Send words to-day. Thomas Merlin, 326 Reaper Block, Chicago.

Song-writers' Manual and Guide Sent Free. Contains valuable instructions and advice. Submit song-poems for examination. We will furnish music, copyright and facilitate publication or sale. Knickerbocker Studios, 319 Gaiety Bldg., New York.

Stamps and Coins.

Best one cent approvals in America. F. P. Hand, 1117 So. 60th St., Phila., Pa.

200 All Different Stamps, including Bosnia, Bavaria, China, Guatemala, Bulgaria, Bohemia, Poland, Turkey, etc., and Dime Stamp Album, only one to customer, all for 25c. Our approval sheets contain bargains priced at 1c. to 5c. net. 150 different U. S. postage and Civil War revenues for only 75c. Indiana Stamp Co., Dept. E, Indianapolis, Ind.

Stamp Collection for sale; over 500 selected stamps collected 12 years ago; $17.00 takes them. Nelson L. Kunkel, 1201 Schuyler St., Utica, N. Y.

South America. Buy direct. 1,000 fine assorted Paraguay, Uruguay, etc., for $2 bill. Exchange rare stamps with collectors and dealers; lots or on sheets. C. P. Mego, Necochea 193, Lomas Dezamora, Argentine Republic.

Have you seen The Stamp Herald? Finest monthly stamp paper published. Subscription 50c. a year. 3 months' trial for 10c. Stamp Herald Publishing Co., Dept. E, Indianapolis, Ind.

300 Different Stamps, 50c. Fred Onken, 630 79th Street, Brooklyn, N. Y.

Stamps—61 All Different Free. Postage, 3c. Mention paper. Quaker Stamp Co., Toledo, O.

California Gold, quarter size, 27c; half-dollar size, 53c. Columbian nickel and catalogue 10c. Norman Shultz, King City, Mo.

Stamps—50 varieties, Transvaal, Brazil, Peru, Cuba, Mexico, etc., and album, 10c; 60 different U. S., 25c; 1,000 hinges, 10c; 1,000 mixed, 40c. List free. I buy stamps. C. Stegman, 5936 Cote Brilliante, St. Louis, Mo.

Coins, medals, paper money, antique firearms. Indian relics, curios, stamps. Catalogue free. Antique Shop, 33a South 18th, Philadelphia.

Big Money. As high as $10 or over paid for cancelled postage stamps. Latest price list for 10c. Ball Supply House, 722 State Blvd., Fort Wayne, Indiana.

Old Coins Wanted.

We Buy and Sell Old Coins. $2 to $500 each paid. Keep All Old Money; you may have valuable coins. Send 10c. for New Illustrated Coin Value Book, 4 x 6. Guaranteed prices. Get posted. Clarke Coin Co., Box 110, Le Roy, N. Y.

Phonographs.

Build your own phonographs and manufacture them for profit. Drawing, instruction, parts price list, blue print, etc., complete, sent free upon request. Write to-day. Associated Phonograph Co., Dept. E 1, Cincinnati, Ohio.

Build Your Phonograph. "Perfection" high-quality spring and electric motors, tone arms, reproducers. Wonderful results. Big saving. New catalog and building instructions mailed for ten cents. Indiana Phonograph Supply Co., Indianapolis, Ind.

Formulas.

1,000 Formulas, 25c. Luminous paint—Resilvering mirrors—Renewing dry batteries—Mechanics' soap—Carbon remover—Gas tonic—Puncture plugger—20c each. Entire collection, 50c. Satisfaction guaranteed. Ideal Book Shop, 5501-EF North Robey, Chicago.

Don't Be a Plugger. Make big money manufacturing household necessities. Six Formulas, 25c. Box 53, Desplaines, Ill.

1,000,000 Formulas. Processes. Trade secrets for every business. 1016 pages, $2. Ideal Book Shop, 5501-EE North Robey, Chicago.

500 Successful Money-making Formulas and Trade Secrets. Postpaid, 25c. Charles Dynes, Winchester, Indiana.

Electrical Supplies and Appliances.

Battery Charging pays big profits with HB Equipment. Electric Light Generators and Motors can also be furnished on easy payments. Full information free. Hobart Brothers, Troy, Ohio.

"If It's Electrical We Have It." Davis Electric Company, 721 11th St. N. W., Washington, D. C.

15c Heavy Brass Binding Posts, 15 for $1.00. 3 point slate base contact switches with binding posts, 35c. Each postage 5c. A. Haupt, 2442 Ogden Ave., Chicago, Ill.

Boys—Here is the simplest and cheapest electric telegraph ever devised. With the "K" Applicator you need no batteries. Get electricity free, instantly anywhere at any time. Send thirty cents (postal money order), for full instructions how to make the "K" Applicator and how to operate an electric telegraph without batteries. Is easier to make and requires less material than you would use in making a kite. Gives constant, smooth, even current day and night, never runs down even upon closed circuit. Works on any metallic line, even barbed wire fence, as no insulators necessary. The "K" Applicator, Missouri Valley, Ia.

Inventors: Models, Dies, Tools, 28 years' experience, work guaranteed, lowest price. Manufacturing of specialties our hobby. Peerless Die & Tool Co., 121 Opera Pl. D. B., Cincinnati, Ohio.

Storage Batteries. Make the plates yourself. We will tell you how. Sample plate, 40c. Windsor Specialty Co. (not incorporated), 5419 Windsor Ave., Chicago, Ill.

Auction Bargain—8,000 complete soldering outfits at 38c each (money order). Soldering iron alone worth more. Harry Fuchs, 1805 Pitkin Ave., Brooklyn, N. Y.

Electrical Workers and All Others—who are interested in electrical work in the reconstruction that is taking place. To send us their name and receive descriptive literature of our modern blue print chart method of electrical wiring. Souvenir information card included. Electrical Wiring Diagram Co., Box C 173, Altoona, Pa.

Mansfield's Automatic Water and Oil Finder a proved success, silver medal awarded. Particulars from Edwin A. Mansfield & Co., 94 Victoria Road, New Brighton, England.

104 Induction Motor Connecting Diagrams. Blueprints in book form. One, two, three, phase. $2.70. International Blueprint Co., Box 87, Gateway, Kansas City, Missouri.

Blueprints—Motor connections. 236 A.C. Single, two, and three phase, including voltage, cycle, phase, speed changing. 123 D. C. diagrams. Shows voltage changing, testing, etc. 120 Transformer diagrams. Single, two, and three phase. 170 rheostats, controllers, compensators, automatic starters, and voltage regulating devices, with both internal and external connections. 10 Samples A. C. 25c. Particulars free. Charles Chittenden, Dept. A, 3024 Matthews Avenue, Kansas City, Missouri.

Experimental Electricity Course in 20 Lessons. By S. Gernsback and H. W. Secor, E.E. A Course of the theory and practice of Electricity for the Experimenter. Every phase of experimental electricity is treated comprehensively in plain English. New Experiments are described and explained and nearly every application of Electricity in modern life is given. 160 pages—400 illustrations. Flexible cloth cover, 75c postpaid. Stiff cloth cover, $1.25 postpaid. Experimenter Publishing Co., Book Dept., 233 Fulton St., New York City.

Postcards and Pictures.

Rare Real Photos. Bathing beauties, models, the kind you want. Sample, dime. Write, Artiste, Auburn, Ind.

High Art Subjects. Beautiful models in classic poses. Send 10c for illustrated miniature reference sheet and price list. United Sales Co., Springfield, Ill.

Real Photos, handsome girl models, rare poses. Samples, 25c. Garvey, E. Perkins Place, Brockton, Mass.

Beautiful Art Post Cards, photographs; state wants. Samples, 25c. Art Studio, 826 Calhoun St., Ft. Wayne, Ind.

Classy Pictures—Do you like real 'snappy" pictures? Boys, these are all nifty pocket size pictures, and we know you will like them. Make fine den decorations. Send for a set today. Prices, $1.00 per dozen; set of 30 for $2.00. Fifty for $3.00. Two samples, 25c. United Sales Co., Springfield, Ill.

Personal.

The Salesman Win$ Thousands of positions open. We teach traveling salesmanship by mail and guarantee offer of position or refund tuition. For interesting particulars address Kansas Vocational Bureau, Miltonvale, Kansas.

Write to famous Hawaiian Beauties, Swimmers, etc., membership 25c. Hawaiian Correspondence Club c/o L. de Roo, Box 306, Honolulu, Hawaii.

Rubber Stamps.

Rubber Stamps made to order. McCaddon Company, Zanesville, Ohio.

Motor Engines and Dynamos.

Make Motors at Home. Complete set of materials and instructions, $1.00. Geo. Willoughby, 403 Waller, Saginaw, Mich.

Small Motors and Generators. Cancelled Government Contracts. A. C. Motors, $9.50 each and up. 12 Light 110-volt generators, $26.50 each; battery-charging outfits, $30 each and up. New motors ¼-½ up to 5 H. P. for all phases and frequencies of current. Write for late bulletin. Bargains in motors and generators. Address Motor Sales Dept., No. 12, West End, Pittsburgh, Penna.

Complete set of drawings of the Liberty 12 Engine. A United States Standardized Aircraft Engine. Giving all views with number of parts, names of parts and weights of parts. Mail $1.00. Dept. A, Ocean Publishing Co., 25 W. 42nd St., New York City.

Motors Electric, we buy, sell, exchange motors of various sizes; large stock; prompt shipments. General Distributing Co., 22 West First St., Duluth, Minn.

Wireless.

Wireless Amateurs, you can build things better from working drawings. Send $1.00 to-day for set of blueprints of an amateur wireless receiving set. Northwestern Blueprint Co., Portland, Oregon. Box 331.

The Audion. Its early history and development, Electron Theory and Trigger Action, compiled by a Chief Electrician Radio who was stationed at the Naval Radio School as Instructor for two years, written by an old amateur for the amateurs in words that they can understand. Also blue print diagrams for hook ups for receiving damped signals, using both air exhausted and gas bulbs. Receiving undamped signals and regenerative circuits. Two-step amplifier, using same (A) and (B) batteries for both steps. Wireless telephony with power bulb. Working blue prints on how to build a "One to One" transformer for use with Audion Amplifier. All for $2.00. Address T. O. McKenzie, 104 Warburton Ave., Yonkers, N. Y.

Complete Receiving Sets, $7.00 and up. With 1,000 ohm receiver, tested mineral; guaranteed. Bulletin for stamp. Jenkins, Room 2, 923 Purchase St., New Bedford, Mass.

Switch Points. Binding posts, switch levers, and small parts; send 2c for catalogue describing these and other goods. A. W. Bowman & Co., 23 Church St. (Harvard Square), Cambridge, Mass.

Just Off the Press—Design and Construction of Audion Amplifying Transformers, Radio and Audio Frequency Type. This latest and important book by Mr. Edward T. Jones, late Associate Editor of "Radio News," will be of great interest to all radio amateurs thruout the land. The transformers shown in these books have never been described in print before, and have usually been considered a manufacturer's secret. Anyone who has several vacuum tubes cannot afford to do without this book because it will enable him to build the necessary amplifying transformers very readily. The designs are very simple and rugged, and anybody can make them without much trouble whatsoever. Mr. Jones, the author, is a practical man who is an experimenter himself and knows whereof he speaks. The book is printed on good paper and has an attractive cover in two colors. Paper bound. Size 5 in. x 7 in. Contains many illustrations, diagrams and working data necessary to build the transformers. Price, postpaid, 25c. The Experimenter Publ. Co., Book Dept., 233 Fulton St., New York.

Attention Amateurs! If you are building your own wireless outfits we can supply you with fibre, and, Bakelite-Dilecto, in sheet, rod or tube, cut to size. Also brass, sheet, rod, screws, and nuts. Switch points, levers, knobs, and binding post. Experimental and machine work, done to your sketches. Send for our new price list at once and save money. O. L. Bortz Machine Co., Greenville, Pa.

Bargain. High Frequency Coils—Tesla style. Electrically correct. Assembled—$6.00. Parts ready to assemble. Secondary wound $5.00. Not wound $4.00. Derrick & Hepburn, Grampian, Pa.

Wireless Course in 20 Lessons. By S. Gernsbach, A. Lescarboura and H. W. Secor, E.E. Tells you everything you want to know about "Wireless" theory, practice and history. A clear, concise course on every phase of this subject. 160 pages—350 illustrations, 30 tables. Flexible cloth cover, 75c postpaid. Stiff cloth cover, $1.25 postpaid. Experimenter Publishing Co., Book Dept., 233 Fulton St., New York City.

How to Make Wireless Sending Apparatus, 100 pages, 88 illustrations. Written and published entirely for the wireless enthusiast who wants to make his own radio apparatus. Contains more information on "How to make it" than any other book we know of. Paper bound, 25c postpaid. Experimenter Publishing Co., Book Dept., 233 Fulton St., New York City.

Aerial wire, seven strand No. 22 pure copper aerial cable. High tensile strength and 100 per cent radiation. Shipping weight 15 lbs. per 1000 feet. Postage extra. No C. O. D.'s at this low price. Immediate delivery. One cent per foot, nine dollars per thousand. Lee A. Bates, 8 Moen Street, Worcester, Mass.

Wireless. (Cont'd.)

How to Make Wireless Receiving Apparatus. 100 pages—90 illustrations. Only strictly modern radio apparata are described in this book and the illustrations and descriptions are so clear and simple that no trouble will be experienced in making the instruments. Paper covered, 25c postpaid. Experimenter Publishing Co., Book Dept., 233 Fulton St., New York City.

Short Stories, Manuscripts, Wanted.

Short Stories, poems, plays, etc., are wanted for publication. Literary Bureau, 165 Hannibal, Missouri.

Song Writers.

Song Writers: You cannot afford to miss our proposition. Reference, any bank or first-class sheet music house. Warner C. Williams & Co., Dept. L, Indianapolis, Ind.

Stammering.

St-Stu-t-t-tering and Stammering cured at home. Instructive booklet free. Walter McDonnell, 105 Potomac Bank Bldg., Washington, D. C.

Instruction.

Crystal Gazing—The craze. Send self-addressed stamped envelope for free instructions. Zancigs Studio Asbury Park, N. J.

Cartooning—Comics and Lettering in fourteen easy lessons. Only $5 postpaid. Over 300 illustrations. Sample lesson, 25c. Ernie's School, Elvria, Ohio.

Learn Dancing.

Learn Fox Trot, Waltz, Two-Step and One-Step in your own home by wonderful Peak System of Mail Instruction. Thousands taught successfully. No music needed. Write for free information. William Chandler Peak, M.B., Room 229, 821 Crescent Place, Chicago.

Musical Instruments.

Violins. Deep, Mellow, Soulful—on credit. Easy terms for wonderful instrument. Get details today. Gustav Henning, 231 11th St., Miami, Florida.

Novelties.

Big Trick and Novelty Catalog Free. United Sales Co., Springfield, Ill.

News Correspondents.

Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 566 St. Louis, Mo.

For Advertisers.

"Quick-Action Advertising—How it is Building Business for the Progressive Advertisers of America": A little story of results, told by the advertisers themselves—not the publisher. You will be interested in reading this little booklet which we have prepared for prospective advertisers, a copy of which will be gladly mailed to you upon request. It tells you how to talk business with 1,000,000 intelligent, interested and responsive Americans every month—men who know what they want and who have the money to buy it. Write for particulars and rates—today. Douglas Wakefield Coutlee, 225 West 39th St., New York.

24 Words in 100 Syndicate Magazines, $1.00; inch display, $4.00. Lists free. Stanford Advertising Co., Pittsburgh.

Money? Jacobus Art Ads make small space pay big dividends. Price $5.00. Write today. Jacobus Service, 1073 Sanford Ave., Irvington, New Jersey.

For the Photographer.

Do you take pictures? Write for free sample of our big magazine, showing how to make better pictures and earn money. American Photography, 465 Pope Building, Boston, Mass.

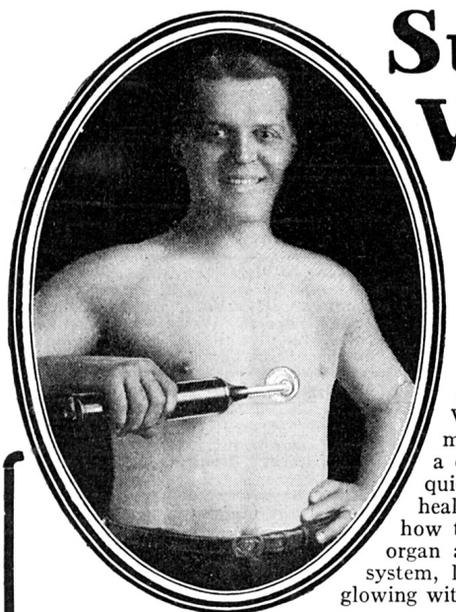
WANT MORE MONEY
HERE IT IS

Hundreds of Men—elderly, young or middle aged make BIG MONEY every month representing our magazines. **Work Your Way Through College,** buy the hobbies you are interested in; or go into a good paying business for yourself. You can spend all of your time or a few hours a day. You can make spending money or you can guarantee yourself a BIG INCOME.

If you can use more money and you are willing to put in a few hours a day don't fail to investigate this offer. You will like the work and no matter what your present pursuits, your faculties will be better developed. Write today for full particulars.

THE EXPERIMENTER PUB. CO.
Circulation Dept., 233 Fulton St., New York

Stop That Pain With Violet Rays!



Superb Health, Vitality, Beauty

WHY suffer from headache, nervousness, rheumatism, skin diseases, or other ailments that keep you from enjoying perfect health, sparkling vitality and youthful beauty? Now through a wonderful scientific instrument you can enjoy all the health-giving, vitalizing benefits of the famous Violet Ray Treatment, right in your own home and at a trifling cost. The Vi-Rex Violet Ray Machine is the new product of science—a machine that is absolutely safe and harmless, so simple that a child can operate it, so effective that you will marvel at its quick results. Prove to yourself that you can have twice the health, twice the energy, vigor and strength you now have. See how these wonderful rays bring new life and vitality to every cell, organ and tissue. See how just one treatment tones up your entire system, leaving you refreshed and rested, your nerves soothed, your skin glowing with healthful color.

FREE—20 Violet Ray Treatments at Home

Once you have tried the wonderful Vi-Rex Violet Ray Machine you will be just as delighted with this amazing treatment as the hundreds of other users, including physicians and beauty specialists who give it their enthusiastic endorsement. That is why we want you to try the Vi-Rex Violet Ray Machine without risking a single penny. We know that you will be so thoroughly gratified with its use that you will not be willing to part with it at any price. So for a limited time we are making this amazing offer: Use the Vi-Rex Violet Ray Machine for ten days in your own home. If you do not find quick relief, if you do not feel better, sleep better, eat better and look better, send it back and you will not be out one cent. Mail the coupon for details of this special, liberal offer. You have nothing to lose, and everything to gain.

Not A Vibrator

This instrument is not a Vibrator. It does not contract the muscles or shock the nerves. Its magic rays pass through every cell and tissue, creating "cellular massage"—the most beneficial electrical treatment known. It leaves no soreness after use, only a delightful sensation of agreeable relief. Its great value is based on proven scientific facts now well established by experience. Violet Rays are used in nearly every modern sanitarium, hospital and health resort. Physicians, osteopaths and chiropractors everywhere use and endorse them. Like thousands of others, you will be amazed at the quick, gratifying results from Violet Ray treatments.

READ What Users and Physicians Say

Trixie Friganza, well known actress says: "Cheerfully will I add my praise for your Violet Ray machine. It's the best 'pain chaser' and 'soother' I've had the good fortune to find. It's WONDERFUL. It cured my brother of neuritis. As for myself I use it for facial treatments and general massage. I cannot say too much for it."

Dr. Bert H. Rice, of Vinton, Iowa, says: "I have good results with the Instrument in all cases of neuralgia. Almost instant relief in Facial Neuralgia."

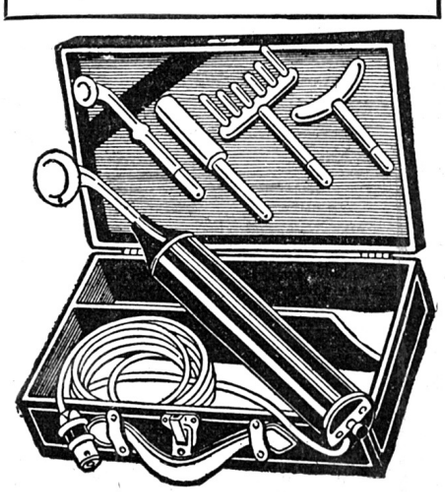
K. L. Allen, D.C., 205 Boone National Building, Boone, Iowa, says: "I have had very good results in cases of Paralysis, Rheumatism and Neuritis, and think it a great help in drugless healing."

Dr. Daniels, Lisbon, North Dakota, says: "Have used it in such cases as Goitre, Bronchitis, Pleurisy, Neuritis, Neuralgia, and Lumbago, and find it very beneficial. In fact, I would not be without it in my office.

Mail Coupon for Free Book and Special Offer

We want you to know in detail about the magic action of Violet Rays. We want you to see for yourself how it has helped thousands of others. We want you to learn what physicians, sanitariums and beauty specialists think about this wonderful new Violet Ray machine. Learn how you can have superb health and radiant beauty. See for yourself the superior points of quality of this instrument which attaches to any lighting socket. All this you will find in this great health and beauty Book which will be sent you free. Simply mail the coupon or write a postal or letter. Do this now, before our special free trial offer is withdrawn.

VI-REX ELECTRIC COMPANY
326 West Madison St. Dept. 42 Chicago



Vi-Rex Electric Co., Dept. 42,
326 West Madison St., Chicago.

Please send me, without any cost or obligation, your free book describing your Violet Ray Machine, and details of your free trial offer.

Name .....

Address .....

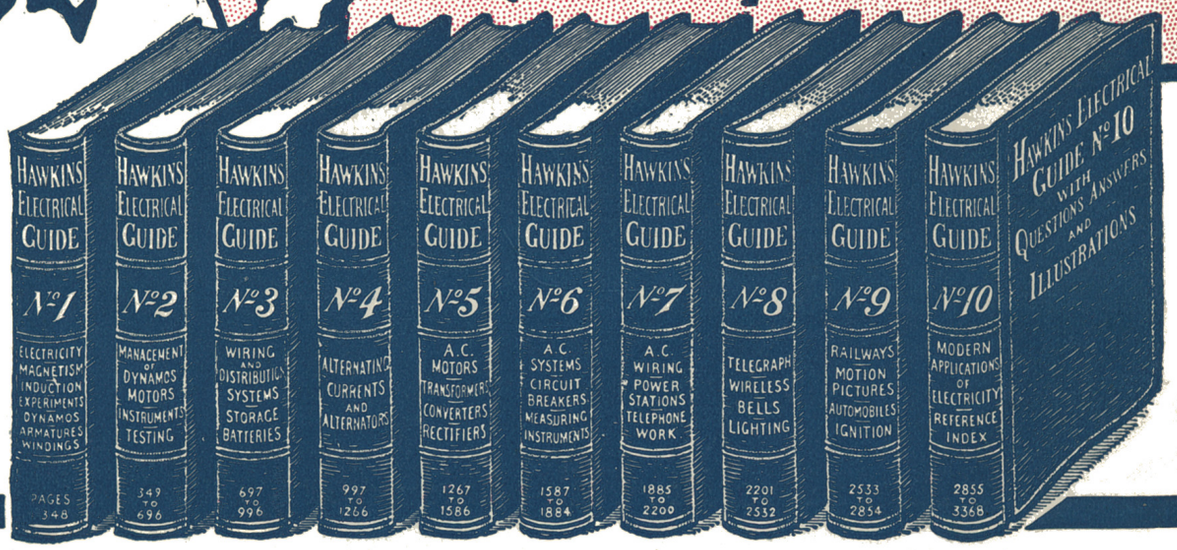
City .....

State .....

Try Violet Rays For

Asthma	Earache	Neuralgia
Barbers' Itch	Eczema	Neuritis
Boils	Eye Disease	Pains
Blackheads	Falling Hair	Paralysis
Catarrh	Hay Fever	Pimples
Chilblains	Headache	Rheumatism
Colds	Goitre	Skin Diseases
Constipation	Insomnia	Sore Throat
Dandruff	Lumbago	Sprains
Deafness	Nervousness	Tonsilitis
	Whooping Cough	

Every Electrical Man Wants These Books and we ship them for your inspection FREE



Flexible Covers — Handy Pocket-Size Volumes

10 Volumes — 3500 Pages — 4700 Pictures

$1 Per Volume

$1 Per Month

Just what you need to know to succeed in ELECTRICITY

EVERY electrician, every engineer, every mechanic should know about these wonderfully helpful instructive books, which give in plain words a complete working knowledge of electrical engineering in all its phases.

You run into some new electrical problem almost every day. The information you need to help you in your every day work is in

HAWKINS ELECTRICAL GUIDES

These books place electricity at your finger ends. They cover every imaginable subject, principle, theory, problem, trouble, and way of doing things electrically. Every subject is indexed so that you can turn right to it. They are a study course and a reference guide in one, written in plain every day language—no wasted words—only what you need to know—chock full of up-to-the-minute electrical knowledge. The guides are a complete course in electrical engineering. They will help you in every detail of the day's electrical work. You can't ask an electrical question that Hawkins Guides can't answer.

READ THIS PARTIAL LIST OF CONTENTS

No. 1 Contains 348 pages, 388 illustrations. Electrical signs and symbols—static and current electricity—primary cells—conductors and insulators—resistance and conductivity—magnetism—induction coils—dynamo principles—classes of dynamos—armatures—windings—commutation—brushes, etc.

No. 2 Contains 348 pages, 394 illustrations. Motor principles—armature reaction—motor starting—calculations—brake horsepower—selection and installation of dynamo and motors—galvanometers—standard cells—current measurement—resistance measurement—voltmeters—watt-meters—watt hour meters—operation of dynamos—operation of motors, etc.

No. 3 Contains 300 pages, 423 illustrations. Distribution systems—wires and wire calculations—inside, outside and underground wiring—sign flashers—lightning protection—rectifiers—storage battery systems, etc.

No. 4 Contains 270 pages, 379 illustrations. Alternating current principles—alternating current diagrams—the power factor—alternator principles—alternator construction—windings, etc.

No. 5 Contains 320 pages, 614 illustrations. A. C. Motors—synchronous and induction motor principles—A. C. commutator motors—induction motors, transformers; losses, construction, connections, tests—converters—rectifiers, etc.

No. 6 Contains 298 pages, 472 illustrations. Alternating current systems—switching devices—circuit breakers—relays—lightning protector apparatus—regulating devices—synchronous condensers—indicating devices—meters—power factor indicators—wave form measurement—switch boards, etc.

No. 7 Contains 316 pages, 379 illustrations. Alternating current, wiring power stations—turbines; management, selection, location, erection, testing, running, care and repair—telephones, etc.

No. 8 Contains 332 pages, 436 illustrations. Telegraph—simultaneous telegraphy and telephony—wireless—electric bells—electric lighting—photometry, etc.

No. 9 Contains 322 pages, 627 illustrations. Electric railways—electric locomotives—car lighting—trolley car operation—miscellaneous applications—motion pictures—gas engine ignition—automobile self-starters and lighting systems, electric vehicles, etc.

No. 10 Contains 513 pages, 599 illustrations. Elevators—cranes—pumps—air compressors—electric heating—electric welding—soldering and brazing—industrial electrolysis—electro plating—electro-therapeutic—X-rays, etc.

Also a complete 126-page ready reference index of the complete library. This index has been planned to render easily accessible all the vast information contained in the 10 electrical guides. There are over 13,500 cross references. You find what you want to know instantly.

What Electrical Men Say

Helped Him Make Good

"It is only right for me to recommend highly the Hawkins Guides, for they have been of the greatest assistance to me in placing me in my present position as Superintendent of Construction Department of one of Ohio's largest Electrical Companies. I would like to see every man have a set of Hawkins Guides."
Geo. Knecht, Columbus, Ohio.

In the Naval Electrical Dept.

"The Hawkins Guides are great help to me in the Naval Electrical Department, which they cover very thoroughly." C. J. Cornell,
U. S. Receiving Ship, Brooklyn, N. Y.

Superintendent

"I am now superintendent of the Dunnville Hydro-Electric Systems, and Hawkins Guides were a great help to me in holding down a responsible position."
W. E. Swartz, Dunnville, Ontario.

Wireless Operators

"I have worked wireless for ten years—but I wish I had these books years ago, as they have saved me a great deal of trouble." H. Marshall.
Steamer M & B No. 2,
Walkerville, Ont.

Pocket-Size Flexible Covers

The books are small enough to slip into your coat pocket—handsomely bound in flexible black covers.

You can carry each volume with you until you have mastered its contents. 3,500 pages of actual information and 4,700 illustrations. Once you see these books and put them into actual use you will never again want to be without them. Try it at our expense.

SEND NO MONEY

It will cost you nothing to receive these books—to look them over—ask them all the questions you can think of—use them in your work—study them—pick up some information that will increase your earning ability. We will ship you the entire set of 10 volumes entirely FREE.

This is a sign of our confidence in the guides. Pure gold does not object to being tested. Keep them for seven days and if you do not decide that you can't get along without them, return them to us and owe us nothing.

When you decide to keep them you only have to pay $1.00 down and remit the balance of $9.00 on the easy payment of $1.00 a month till paid for.

Use this coupon to get the books. It will pay you many times over.

THEO. AUDEL & CO.
72 Fifth Ave. New York, N. Y.

SEND NO MONEY - USE THE COUPON

THEO. AUDEL & CO.
72 Fifth Ave.
New York, N. Y.

Please submit me for examination **Hawkins Electrical Guides** (price $1 each). Ship at once, prepaid, the 10 numbers. If satisfactory I agree to send you $1 within seven days and to further mail you $1 each month until paid.

Signature.....

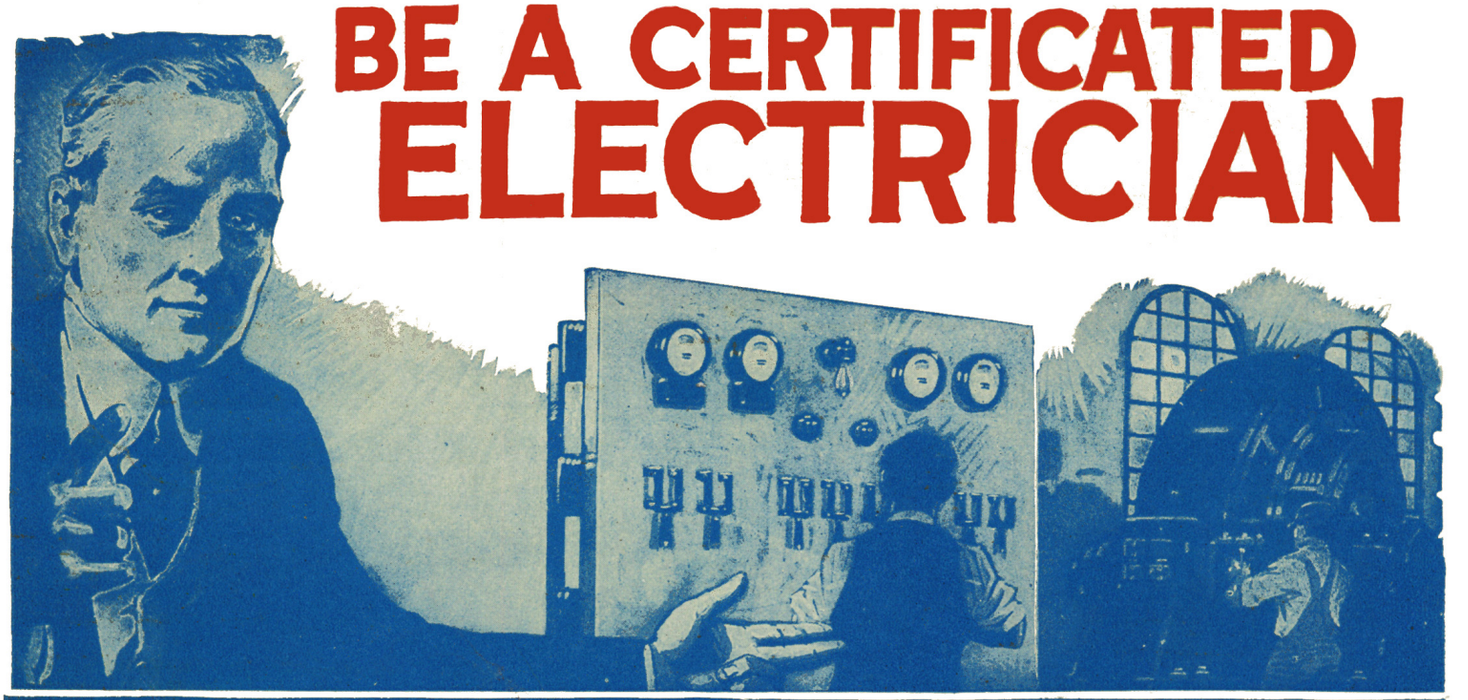
Occupation.....

Employed by.....

Residence.....

Reference..... E.E. Feb.

BE A CERTIFICATED ELECTRICIAN



I WILL TRAIN YOU AT HOME

A real position like this—for you

The country needs thousands of trained **Certificated Electricians** to fill good positions—and at big pay. It's all a matter of knowing how, and I will teach you my up-to-date, modern instruction. You can learn at home, without interfering with your regular work, by my highly successful method of **Home Instruction** in **Practical Electricity.** Prepare NOW, and be ready in a few months to earn your

$60 to $150 a Week

Send for This Book

My Book, "HOW TO BECOME AN EXPERT ELECTRICIAN," has started thousands of young men on the way to splendid success. A new edition of this book has just been printed. I want every young man interested in Electricity to have a copy, and will send you one ABSOLUTELY FREE AND PREPAID. Write me to-day.

How I Train My Students

As Chief Engineer of the Chicago Engineering Works I know exactly the kind of training a man needs to enable him to get and hold good positions, and to earn big pay. I have trained hundreds of men who are holding splendid electrical positions. Many are now successful **Electrical Contractors.**

I give each of my students personal attention and a complete and thorough training. I give him a SPLENDID ELECTRICAL OUTFIT FREE, and much of the training is done by actual work. When my students graduate and receive their Certificate they are ready for a real position. But **still more,** at any time you wish you can come to our splendidly equipped Electrical Shops for special training. No other school can give you this.

A Real Opportunity for *You*

Wishing is never going to make your dreams come true. You've got to **study**—to **learn.** A man is worth $2 or $3 a day from his neck down—and no more; but there is *no limit* to what he can be worth from his neck up.

A trained mind is what gets the big pay. It is this training that you need, and I can train you in a few months. Are you ambitious to make a real success—then send me the coupon—to-day.

Electrical Outfit—Free

To every student who answers this ad I am giving a Splendid Electrical Outfit of standard size. Electrical Tools, Instruments, Materials, etc., *absolutely* free. Furthermore, to every Electrical Student I give a truly *valuable* surprise that I cannot explain here.

Free Employment Service

I am continually receiving requests from employers to send them trained Electrical men. I assist my students to secure good positions. I keep in touch with them for years, helping and advising them in every possible way.

USE THIS "FREE OUTFIT" COUPON

Chief Engineer COOKE
Dept. 22
441 Cass St.
Chicago, Ill.

SIR: Send me at once —fully prepaid and entirely free—complete particulars of your great offer for this month.

Name .....

Address .....

City ..... **State** .....

WRITE NOW—DON'T DELAY

Delay never got you anything. Action is what counts. Get started—and get started now. Write me, or send me the coupon, right NOW.

L. L. COOKE,
Chief Engineer
Dept. 22

Chicago Engineering Works
441 Cass St. **CHICAGO**

YOU CAN DO IT

THE CAREY PRINTING CO. INC.
NEW YORK